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## THE NETTLETON AND KING PAPERS.

Perhaps the truth will have been told were we to say that the papers read by Messrs. Nettleton and King at the late meeting of the American Association will receive a greater share of close attention than that devoted to any other of the literary contributions, excellent as the latter were in every respect. The reason for that greater interest is not hard to find, and lies in the fact that the papers treated, respectively, on subjects which, although diverse enough in the main, appeal to the gas maker with great directness and force. Perhaps the last clause might be modified to the extent of saying that Mr. Nettleton's statements will impress themselves deeper in the minds of those who make coal gas than in the case of those who favor the evolution of water gas; but a like qualification need not be put forward in respect to the subject discussed by Mr. King. Here we meet on common ground, or where all ought to be, and no doubt are, equally interested and anxious to serve one another in the attempt to solve properly a problem which, while it no longer threatens disaster, even yet is a thorn in the flesh of those operating gas plants in many localities.

Returning now to Mr. Nettleton's paper on the "Utilization of Residual Products," we must, at the outset, disagree with the member from Birmingham, Conn., about what he terms an unfortunate selection on the part of the Committee in allotting to him the task of preparing a paper. His fellow members no doubt will agree with us in such dissent, for how can it be otherwise when the lines subsequently submitted by the one selected by the Committee prove the reverse of what their author asserted. Indeed, his paper furnishes the best evidence permissible that the Committee knew their man. We, of course, must concede that, in another and widely different sense—with respect to the press of business in which the Committee's mandate found their victim involved—the designation was unfortunate; but, therefore, all the more praise must be awarded him for his prompt response; and his readiness to serve his fellows, at considerable personal trouble, too, may hereafter nerve some weak brother to follow in similar lines when the call to duty sounds his way.

Unfortunately the American gas maker is altogether too unfamiliar with the European gas works example instanced, in which the entire cost of manufacture was paid for by the receipts from residual products. Still more unfortunate, however, is he from being painfully conversant, if not intimate, with the reverse side of the example—that in which the tar is seen passing away in the waters of some convenient stream, and where nearly all of the coke produced is burned up in the fires of the furnaces. But there is no reason for the existence of the latter state of affairs, since it is simply the inevitable result of indifference, ignorance, or inanity—three very poor staffs, the last being, if not the most excusable, at least worthy of passing pity. However, while life lasts hope exists; and it is with gratification we can say that the dismal parallel becomes less frequent every year. Furthermore, the ratio of rapidity of its extinction increases with the lapse of time, and hence we venture to look forward hopefully in the assurance that at no distant day the rivers will cease, and finally, to act as tar wells, and that the greed of the furnaces will be the easier appeased.

Mr. Nettleton, than whom no more careful and painstaking practical worker in the American gas field have we knowledge of, places this matter of the utilization of residual products before us in such manner as to convince the most skeptical that the avenue leading to "dollar gas" commences at "residual hill." No one will claim for it the virtue, or rather the allurement, of being a broad and easy thoroughfare; on the contrary, it is steep and rugged. But it is a royal road, after all, and one that does lead on to fortune. What has been accomplished by Mr. Nettleton at Birmingham can be accomplished elsewhere—in part, at least—by adopting the policy that developed his success. Perseverance and judgment based on such lines must win the day; and we take this occasion to congratulate Mr. N. on the way in which his labors in the residual field have been rewarded.

Mr. King's paper, although perhaps not dealing with the subject (the

supply of electric light by gas companies) in the manner anticipated, nevertheless leaves no room for doubt as to his own personal opinion on the question. We incline to the belief that many of the delegates expected some close statistics regarding the actual cost, etc., of the operation of the Jacksonville (Ills.) Gas Company's electric light supply annex; but no doubt the wish was father to the thought. Strictly speaking, while the expectation might have been rife, its fulfillment would possibly be a trifle exacting on Mr. King. But in any event the curious can extract solace from the knowledge that if his verdict were not based on facts and figures of an entirely reliable sort, his summing up would have been pitched in a different key. The discussion on Mr. King's paper, however, supplied some of the items not mentioned specifically by him; and it is beyond disproof that the tenor of the debate sustained Mr. King's position on the question at issue. While admitting that the advocates of dual supply seemed to have the best of the argument, we are nevertheless disposed to attach great weight to the objections so forcibly put forth by Mr. Pearson, of Toronto. The fraternity, however, may rest assured that the day is not far distant when this entire matter will emerge, for good-and-all, from the slightest shadow of doubt.

## BOOKS RECEIVED.

We are indebted to the courtesy of Mr. W. H. Bennett, Secretary of the British Gas Institute, for a bound copy of the "Transactions" for 1887. As usual, the volume is well edited, and printed from good, clear type. The illustrations to the papers are copious and well drawn. In addition to the report of the proceedings, the volume contains a list of the names of those on the rolls of the Society, a statement of its finances, the rules of government, a full description of the method of maintaining the benevolent fund, and other matter of general interest. We note that the price charged for delivering a copy of the "Transactions," post free to any address in the Postal Union, is 11 shillings, British.

A copy of the eleventh issue (1887) of "Hasting's Directory of Gas and Water Companies Throughout the United Kingdom" is to hand. This valuable gazette now contains a perfect list of the English Companies, and important statistics concerning them as well. We note that this year Mr. Hastings has attempted, under the head of "Continental," to supply information regarding gas works enterprises in this country. Candor, however, compels the admission that the statistics given are of doubtful value, chiefly because of their incompleteness.

We are in receipt of a copy of Mr. John Allan's "Analyses of the Accounts of English Gas Companies and Corporations"—the compiler, by the way, edits the *Gas World*. The accounts of 29 companies, including some of the largest in the Kingdom, are analyzed in minute and masterly fashion.

Still another English printed visitor is "A Manual of the Manufacture of Gas from Tar, Oil, and other Liquid Hydrocarbons, and Extracting Oil from Sewage Sludge," from the pen of Mr. Wm. Burns, C.E. The treatise is mainly devoted to a description of the author's plans and processes for the accomplishment of the objects set forth. It has a "preface" and an "introduction," both being chiefly devoted to an ill-considered attack on the London *Journal of Gas Lighting*, whose editors, it appears, did not view Mr. Burns' efforts in the line of gas making indorsed or put forth by him as being particularly well qualified to receive their approval. We think Mr. Burns' book would have greater value were the "preface" and "introduction" written in a different strain. Messrs. E. & F. N. Spon are the publishers.

Next we have a copy of the "Report of the Proceedings of the Seventh Annual Meeting of the American Water Works Association," which was held last July at Minneapolis, Minn. Judging from the matter contained in this volume, the Minneapolis session must have been well worth attending. We congratulate Secretary Decker on his editorial capacity, for the report is complete in every respect; and we thank him for his courtesy in mailing us a copy of it. The Standard Printing Company, of Hannibal, Mo., are the publishers.

## Shall Chicago have a Municipal Gas Works?

The following ordinance was introduced by Ald. Gile at a recent session of the Chicago City Council:

"Be it ordained by the City Council of the city of Chicago:

"SEC. 1. There is hereby created a Board of Commissioners of Gas of the city of Chicago.

"SEC. 2. Said Commissioners shall consist of three competent and capable persons, one of whom shall be designated to act as President, one as Secretary, and one as Treasurer.

"SEC. 3. The Mayor shall have the power of appointment and removal, and shall also designate who shall act as Secretary and Treasurer of said Board.

"SEC. 4. The Commissioners when appointed shall be required to give a good and sufficient bond, the amount to be determined by the Mayor, Comptroller and Chairman of the Finance Committee, for the faithful performance of the duties of their office.

"SEC. 5. The salary of the President of the Board of Commissioners shall be $5,000 per annum; of the Secretary, $2,500, and the Treasurer, $2,500.

"SEC. 6. The duties of the Commissioners shall be to construct, maintain and operate gas works, such works to be known as the Chicago City Gas Works, within the city of Chicago, and they shall have the right upon and under all the avenues, streets, alleys and public places in said city for the purpose of placing, operating, repairing and maintaining one or more lines of gas mains and pipes, and all necessary feeders and service pipes in connection therewith, for lighting and fuel purposes.

"SEC. 7. Said Commissioners shall be under the control and direction of the Commissioner of Public Works, as to use and repair of the streets of the city, and subject to all regulations and ordinances concerning the same.

"SEC. 8. The city of Chicago shall not be held liable for the payment of principal or interest on any bonds that may be issued by said Commissioners for the purpose of erecting gas works or maintaining them.

"SEC. 9. The Mayor, Comptroller and the chairman of the Finance Committee shall from time to time, and as often as once in each month, carefully examine into the management and affairs of said Commissioners of Gas, and said Commissioners shall as often as once in each month submit a written statement of the condition of the works under their charge and all matters pertaining thereto.

"SEC. 10. The Council may from time to time appropriate funds toward the erection and maintenance of such works. For such appropriation the Comptroller shall receive bonds signed by the President and Treasurer of the Gas Commission. Such bonds shall draw interest at the rate of 5 per cent. per annum, and shall be a lien on the gas works of said city of Chicago, but such bonds shall have no prior claim over other bonds issued by the said Commissioners for the same purpose.

"SEC. 11. The Council may determine the price charged to consumers for gas, which price shall be determined from time to time by the actual cost of production, after providing for the liabilities of the gas works, for interest and expenseses, and a sum to be set apart as a sinking fund for retirement of the bonds and extension of the works; provided, that the maximum price charged shall not exceed $1 per thousand feet for gas.

"SEC. 12. This ordinance shall take effect and be in force from and after March 1, 1888."

Referred to Committee on Gas.

## Trenching and Pipe Laying.

[Abstracted from a paper (by Wm. R. Billings, C.E., on "Some Details of Water Works Construction,") contributed to the *Engineering and Building Record*.]

A trench which is troublesome on account of caving grows worse the longer it is open; if, then, the trenching gang is a good distance ahead of the pipe layers, and water and quicksand are found within two or three feet of the surface, it is wise to send the diggers ahead on to dry ground, or make some other arrangement, so that the last two or three feet in depth of the wet trench will not be opened until pipe can be dropped into it. When caving occurs in wet, heavy ground some warning of the impending trouble is given by cracks in the surface, running nearly parallel to the side of the trench; but in sandy gravel the drop comes without warning, and men may be seriously injured. In any case the tendency to caving is increased by the weight of the excavated material piled up on one edge of the trench; and if circumstances will permit, it is well to keep men on the bank to shovel back the material as fast as it is thrown out.

In soil that will allow it, tunneling will often save the public and individuals much inconvenience by carrying the trench under crosswalks, driveways, and railroad crossings, and the only tools needed are the tunneling bars mentioned in the list of tools, and long-handled shovels. A little practice and boldness in this detail will give very satisfactory results.

In these cases bell-hole digging and joint making must be done together, and some suggestions upon this detail will be given later.

With cast iron pipe, when the digging is good and the trench stands up well, it pays to put three, four, or half a dozen men at work digging bell-holes—that is, enlarged places in the trench, spaced so as to come about the joints of the pipe, and large enough to give a man room to swing his hammer and get at all parts of the joint without unnecessary fatigue. There is little or no danger of getting the bell-holes too large, and plenty of room for the calker will do not a little toward insuring tight and strong work. The bottom of the trench should be dug out 8 or 10 inches for a length of 4 feet beyond the joint, and the sides worked out on the same scale to give ample shoulder room. These directions will have a queer sound when one is trying to make joints in quicksand, and at such a time fixed rules amount to but little. No end of grit, plenty of hard work, with some little planning, will make joints in places that seem all but hopeless for the first half-hour.

Neither stony nor rocky trenches offer any serious difficulties, and even in ledge-work it is simply a question of time and money. If the bottom of the trench comes in rock which must be worked out by drilling and blasting, the ledge should be cut away to a depth which will allow sand 6 or 8 inches in depth to be spread upon the rock, in which the pipe may be imbedded. If boulders are encountered which are too large to be taken out by the derrick, they should be well cleared from the confining earth by digging before applying powder or dynamite; this gives the explosive a fair chance, and digging is cheaper than drilling and blasting. Large pieces may sometimes be worked off from a boulder or ledge which projects into the trench, without using explosives, by means of small hand-drills and "feathers and wedges." To do this drill ¾-inch holes with a short steel drill and stonemason's hand-hammer along the desired line of fracture, 8 or 10 inches deep and 6 inches apart; drop a pair of feathers made of ¾-inch half round iron into each hole, and drive the wedges between each pair.

In blasting, the nitro-glycerine preparation known to the trade as "forcite powder" is comparatively safe, and gives better results than common gunpowder, for it will shatter rocks more thoroughly and with less tamping. To fire a 1¼-inch hole 3 feet or more in depth, take a whole forcite cartridge, cut off perhaps half an inch in length, and set a percussion cap pinched on to the end of a piece of fuse into this short piece of the forcite by boring out a small hole with a knife. Lower this into the whole, and cover it with the remainder of the cartridge broken into small pieces between the fingers, and fill up the hole with earth tamped down with a stick.

Such a charge as that will let daylight into any rock that a pipe gang is likely to encounter, but the blast should be carefully loaded with logs, timbers, or railroad ties chained together, and covered with brush to arrest small pieces which may do damage if allowed to fly away. This forcite powder may be used to loosen a troublesome boulder, by simply poking a hole into the bank alongside of it, and tucking in a little of the explosive folded in an envelope and held in place by a slight packing of earth; or a cracked and seamy rock may be thoroughly split by dropping an envelope full of the powder into one of the cracks, and firing by cap and fuse in the usual manner.

Rocks which appear in the bottom of a wet trench are unwelcome enough, but it will not do to leave them in such shape that a pipe will be supported by them in the middle with the weight of the back-filled earth bearing on the ends lying in soft ground. If the expense of getting out the rock seems too great, the depth of the trench should be reduced until a firm and even bearing can be secured.

On all trenches that do not stand up well, or that must be made wide to get out rocks, a long three-legged derrick will be found exceedingly convenient, for its range is wide, and it can straddle fences in a right handy fashion.

*Pipe-Laying.*—When 100 feet of trench has been bottomed out it is time to make up the derrick gang, and begin the work of putting the pipe into the ground. For 6, 8, or 10 inch pipe six men are enough, and they should be strong, active, and intelligent laborers. Men who are employed in this gang generally expect, perhaps, 25 cents per day more than the average digger, and good men in the place are worth it. It is not well to let the fellows who may be first chosen for this gang think that they are indispensable, and if one of them happens to be off a day, do not hesitate to take any good man out of the trench to fill the vacant place.

The first thing that a green lot of men must learn is to raise and carry the derrick, assuming that it is to be of the three-legged style referred to in a previous chapter. It is to be raised, first, just as a ladder should be, by footing the bottom and walking it into an upright position; then let one man grasp the pin on the middle leg with one hand and the leg with the other, a man at each of the other legs holding them firmly, and carry it straight away 5 or 6 feet; spread the other two legs the same distance, and the derrick stands alone, though perhaps not very firmly. A little study of the structure will now show that the legs may be spread as far apart as need be, provided always that lines joining the feet of the derrick form either an isosceles or an equilateral triangle, the line joining the two outside legs being the base. In placing over the trench, the middle leg should stand on the side which has the largest quantity of earth upon it. The man carrying the third leg, as the derrick is moved along from pipe to pipe, should grasp the pin firmly when the time for moving comes, throw his weight toward the trench, and be careful to keep midway between his comrades who are carrying the outside legs, and they in turn should walk as close to the edge of the trench as practicable, resist the push of the derrick firmly, and keep about 10 feet apart.

A man at each leg, another to carry the rope, and two men in the trench, make an ordinary derrick gang; for handling 16-inch pipe more men will be needed in hoisting and placing. The smaller sizes of pipe can be brought from the side of the road to the trench by means of the carrying sticks. These sticks thrust into a pipe give good lifting hold, and two stout fellows at each end, shoulder to shoulder, will carry 4-inch easily, and 8-inch without overwork. Skids of 4 x 4 spruce thrown across the trench may support the pipe while the derrick is put in place over it; a sling of rope is then to be passed around the pipe enough nearer to the bell than to the spigot end to cause the spigot end to fall easily into the trench when the pipe is lifted by the tackle from the skids. As the skids are removed to allow the pipe to be lowered into the trench, let one of the men bunt the pipe with the end of the skid to clear the pipe from sticks, stones, and dirt. This is not enough, however, and it should be the duty of the men in the trench to look through the pipe as it comes down to them, and make sure that no one has either maliciously or carelessly left therein an old hat, or a pair of boots or overalls. These remarks are not in jest, for just such combinations of what the doctors might call incompatibles have been made.

As the pipe is lowered one of the trenchmen enters the spigot into the preceding bell, his comrade assisting as best he can; but before the pipe rests on the ground it is well to swing it in like a ram against the pipe already laid, to make sure that the joints ready for calking are all "home." As soon as the pipe rests on the bottom the foreman should straddle the trench at a convenient point ahead of the derrick, align the pipe just laid, and look back over the line for joints which may be improved.

The trenchmen should carry bars with them to throw the pipe, and not try to use shovels for levers. Attention should be given to vertical alignment, as well as horizontal, and if grades are not given by an engineer, and no use is made of a carpenter's level on the pipes, the vertical alignment may be kept within bounds by keeping the joints of the same width at the bottom as at the top. If the bell end of a pipe when it rests on bottom is found to be too low, raise it with the derrick, throw rather more than enough loose dirt under it, and then drop the pipe down hard on this two or three times. As soon as the pipe is in position a few shovelfuls of earth should be thrown on to the center of it to hold it, and if the trench is bad, the section between the joints may be half filled at once, as this will support the bank and counteract any tendency to caving. With 4 and 6-inch pipe and a troublesome trench, two or three lengths may be put together on the bank, the joints made on dry land, and then with two derricks and careful slinging three lengths may be put into the trench at once without straining the joints. The few joints that must be made in the trench may, in quicksand, seem at first like hopeless cases, but persistence and no thought of ultimate failure have conquered the most cases that have come in the experience of the writer. In such instances it is useless to attempt to get the sand down so as to make the joint right through without stopping to dig out again. Let the calker stand on the pipe while a good man with a shovel, perhaps a lot of sod, and some pieces of plank, clears away and holds back the stuff so that the joint may be yarned if not poured. If the sand rises as the shoveling ceases, let the calker do all he can by quick work, and then rest, while another attempt with planks, sod, pails and shovels, is made to make room for him. In general, whatever means are employed to make and maintain room for joint making in quicksand, let the preparations be thorough; let the plank be driven as deep as possible and well braced, sods provided in large quantities; have pails or a good ditch pump, and good strong men who are not afraid to "pitch in."

In order to locate gates or special castings in a particular spot, or to bring a joint into a more accessible location it is frequently necessary to cut pipe.

For this use an 8 to 10-pound sledge, and a long-handled cutting-off tool; put a skid under each end of the pipe, placing one directly under the line of cutting, and get a firm and even bearing on the ground for its whole length. A line for the cutter to follow may be had by winding the end of a tape line about the pipe, and marking along the edge with chalk, but a little practice will enable one to guide the cutter as the pipe is slowly rolled on the skids, so as to make a square cut. The blows of the sledge should be rather light for the first time around, and then when the cut is well marked so that it may be easily followed, the blows may be swung in with vigor.

The pipe should at some stage of the work be carefully inspected for cracks, which are oftenest found at the spigot end. If a crack in a spigot end is very slight and so short as to be more than covered by the bell, we may not think it worth while to cut the pipe; but a long crack obliges us to waste nearly twice its length of pipe, for the cut must be made at least 6 or 8 inches above the visible end of the crack, and even then the jar of cutting may cause the crack to run still further into the sound metal.

## ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

New York Sends Fireclay Material to British Columbia.—We are, through the courtesy of Mr. Adam Weber, of No. 633 East 15th street, this city, enabled to say that the first shipment of firebrick material ever sent from this country to British Columbia was made by him on the 28th of last month. On that date Mr. Weber forwarded, *via* the N. Y. O. and W. and the Canadian Pacific Railways, four cars containing clay retorts and settings, complete, for two benches of 6's to be constructed on the Weber half-depth regenerative furnace plan at the works of the Victoria Gas Company.

Annual Election.—The annual meeting of stockholders in the Narragansett Electric Lighting Company was held at No. 52 Aborn street, Providence, R. I., on Oct. 28. The following were elected: Directors: H. E. Wellman, I. M. Potter, J. M. Ripley, F. H. Peckham, Jr., S. C. Blodget, Jr., M. H. Hartwell and M. J. Perry. At the organization session, held Nov. 3, the following officers were chosen: President, H. E. Wellman; Vice-President and General Manager, M. J. Perry; Sec. and Treas., D. A. Peirce.

Will it be Upset?—Some time ago we announced that the plant and franchise of the Findlay (Ohio) Gas Light Company had been purchased by the city authorities, who proposed thereafter to act in the capacity of public lighting suppliers. It seems, however, that the sale is to be contested, as the following letter proves. Our informant, under date of 2d inst., says: "An injunction suit has been filed in the Court of Common Pleas for Hancock County, Ohio, which is likely to attract a great deal of attention in the Northwestern section of the State. Several months ago the Findlay Gas Light Company made a proposition to the City Council, offering to sell the gas plant to the latter for the sum of $75,000, the purchase money to be paid in the shape of bonds guaranteed by the city. After considerable debate the Council accepted the offer, the chief argument being that this afforded the only means by which the war of gas rates could be brought to a termination—I presume it is known that the city had been in the field as a competitor for favor against the old Findlay Company in the supply of natural gas for lighting and heating purposes. It is also asserted that this rivalry was causing a loss to the city of something like $10,000 or $15,000 per annum. Two weeks ago the plant was turned over to the city's gas trustees, and bonds in the sum named were issued to the Gas Light Company. It seems that the latter speedily repented the course taken, because, on the morning of the 2d inst., Dr. Chas. Osterlin, President of the old Findlay Company, acting in concert with several stockholders, filed a petition praying that the sale be set aside, on the ground of illegality. They assert that the City Council had no authority to issue the bonds, that the Board of Directors of the Company had not consulted them in regard to the sale, and that the terms are very unsatisfactory to complainants. Putting one thing against another, the Findlay sale appears to have been an odd sort of a bargain."

Will Lancaster (Pa.) have a Municipal Lighting Station?—At a recent meeting of the Lancaster Select Council Mr. Remley presented a resolution to instruct the Lamp Committee to inquire into the feasibility, and to figure on the cost as well, of converting the old water works building into an electric station for the purpose of electrically illuminating the city. Mr. Remley's associates agreed with him, and unanimously indorsed the resolution.

All over the State?—The Leavenworth (Kas.) *Times* says there is not now a town in Kansas, containing a population of 3,000, that is without some system of electric lighting.

Increasing the Capital Stock.—Some time ago we chronicled the incorporation of the Cicero (Ills.) Water, Gas and Electric Light Company, the initial capitalization of which was placed at $65,000. The stock has been increased to $200,000.

Rome (Ga.) to Try the Combination Idea.—We have it on pretty good authority that the owners of the Rome Gas Light Company are about to add an electric lighting station to their present gas plant.

Gas Turned on.—The proprietors of the Standard Gas and Electric Light Company, whose headquarters are at Independence, Iowa, have successfully inaugurated the gas works just completed by them at Macon, Missouri. Gas was first supplied on the night of October 29. It is fully expected that the city authorities will soon enter into a contract for the lighting of the streets of the town by gas. Macon (or Macon City) is the capital of a similarly-named county in Missouri, and is located midway of the streams known respectively as the East Chariton River, and the Middle Fork of Salt River. It is on the Hannibal and St. Joe Railroad, at a point 70 miles west of Hannibal, 60 miles east of Chillicothe, and 20 miles north of Moberly. A valuable deposit of coal has been found close by, and this insures its prosperity as a manufacturing center. In fact many large establishments—chiefly devoted to the manufacture of farming implements, wagons, etc.—are now in active operation there. Population, close to 6,000. The local post office, by the-way, bears the name, "Macon City."

Proposals for Street Lighting, Cleveland, Ohio.—Mr. Walter P. Price, City Engineer, Cleveland, Ohio, informs us that sealed proposals will be received at the City Clerk's office—rooms 32 to 35 City Hall—until 12 M., Wednesday, Nov. 30, for furnishing light, lighting, extinguishing and care of about 4,300 gas, and 2,300 vapor or gasoline lamps, and for twenty-six 4,000-candle power electric lights, on masts, and 40 (or more) 2,000-candle power electric lights on posts, arches or brackets, the contracts to cover a period of one year from December 1st next. Specifications may be seen and blank form of proposals can be obtained at Mr. Price's office. Each proposal must be accompanied by a bond in $5,000.

A Novel Suit.—Recent Philadelphia (Pa.) advices state that Jacob H. Armbruster, who had occupied the premises, 1635 Chestnut street, in the Quaker City, has instituted suit in the Common Pleas against the executors of the estate of Aaron A. Hurley, who are now the owners of the premises, No. 1637 Chestnut street. On June 9th last an explosion of gas occurred in Mr. Armbruster's store and house, whereby, as he alleges, his stock-in-trade and household goods were damaged to the extent of $1,000. He says the walls of No. 1637 had settled and strained the gas pipes so that the latter leaked badly, the escaping gas subsequently entering his house and causing the damage complained of. He claimed that if the gas had been shut off—No. 1637 was vacant at the time—the accident would not have happened, hence defendant's liability through lack of ordinary caution.

Some Changes in West Troy's Gas Supply.—A correspondent kindly sends the following: "The connection between the mains of the Municipal Gas Company (Albany, N. Y.) and the holder of the West Troy Gas Light Company has been made, and West Troy consequently uses illuminating gas manufactured in Albany. The connection was made by laying 7,600 feet of 8-inch pipe, from Spring street, on the Albany road, through Salem and Saratoga streets, to the canal, thence along the canal banks to Schenectady street, through that street and Federal and West streets directly to the works of the West Troy Company. Gas making in West Troy has been discontinued for the present, but the works are in such shape that they could be started, if necessary, at short notice. The distribution is, as heretofore, from the West Troy holder. In 1877-8-9 gas was furnished to West Troy from Albany, without an intermediate holder, with the result that the pressure was variable and the supply unreliable and unsatisfactory. By the present arrangement, however, the distribution conditions are the same as if the gas were made on the spot. A reduction ere long is expected in the price of gas, which is pronounced excellent in quality and of high illuminating power. At a meeting of the West Troy Gas Light Company, held Nov. 4, the resignations of the following Directors were received and accepted: G. W. Chapman, F. J. Parmenter, W. A. Thompson, A. H. Sweeney, A. T. Phelps, and R. F. Hall. In their places were substituted Messrs. R. Brice, C. L. Pruyn, W. McEwan, E. A. Groesbeck, L. Cogswell, and E. J. Hussey. R. Bryce was chosen President, and C. L. Pruyn Secretary. T. A. Knickerbacker is the only one of the old Board of Directors who remains, and he also retains his position as Treasurer. R. F. Hall will continue to be Superintendent of the works at West Troy. Messrs. A. N. Brady and R. C. Pruyn, respectively the President and Vice-President of the Municipal Gas Company of Albany, recently purchased a majority of the stock of the West Troy Company, and thus obtained control of its property."

Can This Account for Some of Henry George's Queer Talk?—During the late political canvass in this State Mr. Dana's paper published a letter from the pen of that celebrated orator (so famous for his San Francisco anti-Chinese "sand-lots" harangues), Denis Kearny, in which the writer asserted that George's earliest political attempt consisted in the successful lobbying through the California Legislature of a measure creating an inspector of gas meters for that State. The lobbyist, it is claimed, was the first one to fill the office so created, although the gentleman from the "sand-lots" intimates that the inspector's chief duty under the act was simply to draw an "unearned increment" from the treasury.

In Charge at Aurora, Ills.—We notice, from instructions received to change the address of a subscriber, that Mr. Wm. B. Miller, formerly in charge at Appleton, Wis., is now Secretary and Supt. of the Aurora (Ills.) Gas Light Company. We wish him every possible success.

The Men at the Helm.—The Louisville (Ky.) Gas Company was organized in 1838, since which time only six individuals have occupied its Presidential chair. The occupants' names, with their respective terms of office, are appended: L. L. Shreve, 1838 to 1854; R. G. Courtenay, 1854 to 1865; J. L. Smith, 1865 to 1877; H. Whitestone, 1877 to 1884; John G. Baxter, 1884 to 1886; G. W. Morris, 1886 to—let us hope for many years. This list reveals the names of men who, in their day and time, were honored by their fellow-citizens, and whose memories will be recalled with pleasure.

A Change Proposed at Wheeling, West Va.—We understand that a change is about to be made in the method of gas making at the Wheeling City Works. It is probable that a process something similar to that of the McKay-Critchlow sort will be adopted.

Annual Meeting, Waukesha, Wis.—The annual meeting of the Waukesha American Gas Company was held on Oct. 31. The following officers were elected: President, A. J. Frame; Vice-President, C. E. Gray; Secretary, T. W. Haight; Treasurer, Thos. Robbins, Jr. The business for the year, as shown by the books, returned a fair rate of interest on the money invested. This Company has adopted the combination plan.

Bids for Public Lighting, Conshohocken, Pa.—At a recent meeting of the Town Council the chief item under discussion was the public lighting contract. The following bids were submitted: Conshohocken Gas Light Company—two proposals. First, to furnish 83 or more 16-candle power incandescent lights at the rate of $15 per year each; second, to light the streets by means of gas lamps, equipped with 5-feet burners, at $18 per year each; or with oil lamps, of the pattern now used, at the rate of $13 each per year. These prices to include the cost of lighting and extinguishing and keeping in order. The Penn. Globe Gas Light Company offered, on the basis of a 5-year contract, to supply a 16 to 18-candle power vapor light for $22.75 per lamp per year. A syndicate offered to supply a 25-candle power incandescent lamp for $1.75 per lamp per month, and guaranteed to have their plant in operation within 90 days of the date of acceptance of the proposition. A motion, by Councilman White, to accept the syndicate proposition was defeated, and the body then adjourned.

New Lighting Company.—Articles incorporating the Kearney Gas and Electric Light Company have been filed with the Secretary of State, Nebraska. The capital stock is placed at $50,000, and the Company limits its indebtedness to two-thirds of the paid-up capital. Messrs. A. S., E. O., and G. L. Maxwell are the incorporators. Kearney is a post-town of Buffalo county, Neb., on the U. P. and St. Joe and Denver Railroads, at the west terminus of the Burlington and Mo. River Road. It is near the Platte river, is 195 miles west by south of Omaha, and 136 miles west of Lincoln. Elevation, 2,150 feet; population, about 4,000.

De Land, Fla., is to be lighted by electricity, and the material for the station is now on the ground.

Gas is to be used at an early day for the illumination of the chief public buildings in the town of Natchitoches, La. Natchitoches (pronounced nak'-e-tosh) is on Cane river, at a point 75 miles south-southeast of Shreveport.

Combining at Galveston, Texas.—We understand that a consolidation has been effected between the Galveston Gas Light Company and the local electric light company, the stockholders in the former having ratified the agreement on the 8th inst. This probably means more work for Brother Beck. A man who had the courage to crawl through some of the Pennsylvania gas coal mines, which he did not such a great while ago and that merely for pleasure, is not likely to consider the new branch of duty thus imposed on him as much of a hardship.

New Electric Light Company.—The Olean (N. Y.) Electric Light Company has been incorporated by Messrs. G. V. Forman, W. V. Franchett, O. T. Coon, L. L. Bartlett, F. W. Higgins, W. Irish, C. S. Stowell, J. Kelsey and L. E. Chapin. Capitalized in $25,000.

A Gas Machine will Furnish the Gas.—On Oct. 25 the Trustees of the Hospital for the Chronic Insane (located at Agnews, Cal.) authorized Messrs. A. F. Nye & Co., of San Francisco, to supply them with a 500-light gas machine for the lighting of that institution. Nye & Co., are to be paid $3,000 under the contract, which we presume includes the cost of piping, etc.

A Bit of Baltimore (Md.) Gossip.—Mr. E. C. Benedict, speaking on the subject of the changes now going on concerning the Baltimore Gas Companies, said: "We propose in the consolidation to utilize the plant of the Equitable Company in manufacturing cheap fuel gas for the purposes of generating heat and power. We will begin, say, by charging 75 cents per thousand cubic feet; and it may be, provided we secure consumers enough, that we can furnish it for less."

Reversing the Decision.—The Butte City (Montana) Council, about a month ago, decided to enter into a contract with the local Gas Company for the lighting of the city's streets, which action meant the substitution of gas for electricity. The electricians, however, seem to have been equal to the emergency, for we now have information that, on October 29, the Council rescinded its first decision, and then awarded a contract to the electric light men, under the terms of which they will draw a greater sum of money from the public funds than they drew before. Weather-cocks would appear to abound in Butte City's Councilmanic circles.

We understand that, at a recent election held by the freeholders of Roanoke, Va., it was voted not to light the streets by electricity.

Result of a Suit for Damages.—We are informed that, in accordance with a verdict rendered in the local Circuit Court, Wm. B. Oliphant has been awarded damages in the sum of $5,000 in his suit against the Danville (Ills.) Gas Light Company. Complainant, who is a dealer in plumbers' and gas fitters' supplies, with place of business in Chicago, was in Danville, on date of August 19, and, while hurrying to the depot to catch a train, he stumbled into a trench that had been opened by the Gas Company for the reception of a pipe. The stumble cost him a broken ankle, hence the suit. He asked for $10,000.

About Completed.—The "South-end" gasholder now being constructed for the Springfield (Mass.) Gas Company is rapidly approaching completion. The slate roof to the house is being put on, and it is expected that gas will be turned into the holder on or about December 15. The completion of this holder guarantees to the Company storage facilities for something like 600,000 cu. ft. of gas.

One Thing that was Witnessed!—The Cleveland (Ohio) Board of Improvements recently deputized a party of four to visit Bellevue, Ky., for the purpose of inquiring into the merits of a gas manufacturing process in operation there. Of course, the deputies had a pretty good time, and seem to have been convinced that the Bellevue process, so-to-speak "takes the illumination." In talking about the wonderful things they had seen the deputies mentioned the following to a Cleveland *Press* reporter: "At one of the tests three quarts of water were boiled in considerably less than two minutes, but the volume of gas required to do this was not ascertained!" Somewhat like the ancient parallel about attending a performance of "Hamlet" whereat the melancholy Dane failed to put in an appearance.

A Hint from Manchester, N. H.—At a meeting of the Manchester City Fathers, held on the first inst., the rules being temporarily suspended in order to expedite the transaction, the following resolution was passed: "On account of the extravagant cost of lighting our streets by the present method, it is moved that a joint standing committee of two Aldermen and three Councilmen be appointed to investigate the cost and feasibility of establishing an electric light plant for the city." The committee selected includes Alds. Eager and Reynolds, with Councilmen Kendall, Bohan and Woodbury.

What is the Matter with the Proprietors?—We have been told by a gentleman, just home from a visit to the Isthmus, that the Panama Gas Company's plant is in a very dilapidated condition. This is a queer state of affairs, for, with proper management, an enterprise of that sort in the locality named ought to prove a profitable one to those in charge of it.

Quite a Good Showing.—So far this year the National Gas Light and Fuel Company, of Chicago, Ills., have put in their Springer cupola gas system in 15 different gas works. The total daily manufacturing capacity represented by these contracts figures out at something over 4 millions cubic feet.

Progress Made on the Vancouver (Brit. Col.) Gas Works.—Some time ago we noted that Vancouver was to have a gas plant, and we can now add that the work of construction has been prosecuted with remarkable vigor. The buildings are well underway, the gasholder is finished, and about 2½ miles of mains have been buried. The proprietors hope to begin the supply of gas in a month or so, and we congratulate them upon having secured the services of such an enterprising and clever man as Mr. J. L. Stamford, who acts in the capacity of Manager and Engineer of the Company. Vancouver has had an electric light company in active operation for some time back, but the service does not seem to give general satisfaction. However, the residents will soon have a chance to compare the merits of the two systems of illumination.

Chartered.—The Peoples Heat, Light and Power Company, to operate in Fort Scott, Kansas, has been incorporated by Messrs. A. A. Harris, W. C. Gunn, C. H. Osborne, E. P. Ware and D. Prager. Is is capitalized in $100,000.

The Gasoline Stove.—The Kansas City (Mo.) Fire Department apparatus was called out twice on the 29th of October to extinguish conflagrations caused in each instance by the explosion of a gasoline stove. The total damage amounted to $6,500. Better use gas stoves. They are cheaper than the gasoline apparatus even when the results are calculated in dollars and cents. Safety, however, ought to be worth something.

Going Lower in London, England.—We note the Directors of the Gas Light and Coke Company, London, have resolved, from and after the 1st of January next, to reduce the price of gas to private consumers on the north side of the Thames river to 67 cents per 1,000 cubic feet for common gas, and to 84 cents per 1,000 for cannel gas. They have also resolved, from and after the same date, to supply the public lamps over their entire district at 53 cents per 1,000 cu. ft. for common gas, and at 65 cents per 1,000 for the cannel quality.

Public Lighting at Portland, Maine.—The Portland City Council decided to accept the bid submitted by ths Consolidated Electric Light Company for the public lighting of that city, the contract to begin on November 1, 1887, and to terminate on Oct. 31, 1888. The Company agreed to maintain 168 arc and 250 incandescent electric lamps in consideration of a total annual payment of $25,000. Each additional arc ordered is to be paid for at the rate of $140 per year, $18 per annum to be paid for each extra incandescent lamp ordered. Last year the electric lighting of the city cost the taxpayers $18,000.

They Want Gas.—The residents of Menominee, Mich., are agitating the subject of a gas supply. The situation seems to be a favorable one. Menominee is the capital seat of a similarly-named county, and is located at the junction of the Menominee River and Green Bay. It is 52 miles northeast of the city of Green Bay. Population, about 4,200.

Heard from Once More.—Our last information concerning Brother Cressler's whereabouts appeared to locate him at Chattanooga, Tenn., where, something like a fortnight ago, he was busily engaged in completing the additions made by the Kerr Murray Company to the local gas plant.

The Cost.—It is estimated that the sum of $60,000 has been expended in carrying out the extensive system of improvements made on the works of the Burlington (Iowa) Company this season. Quite a round sum.

The capital stock of the Newburgh (N. Y.) Electric Light Company has been increased to $150,000. Additional apparatus has been purchased.

An "Approved" Electric Lamp Post.—It seems that President Hess and Engineer Kearney, the committee appointed by the New York Board of Electrical Control to adopt a design for uniform lamp posts to be erected by the electric light companies of this city in the future, have fixed upon a design, and no permits will be granted by the Board for the erection of lamp posts of any other pattern, unless for some special reason the specimen adopted is shown to be impracticable in certain parts of the city. The selected design contemplates a pole 20 feet high, exclusive of the lamp frame. For a distance of 7 feet from the surface of the ground the pole is to be of iron, the remaining 13 feet to be of hard wood. This combination of materials is intended to prevent, in a measure at least, all danger to human life by shocks, as the wires carrying the current will not be visible at any point on the iron pedestal. The post is to be ornamental in design, and no part of the pattern is covered by any patent.

Policemen do not Want to Act as Lamplighters.—The Pittsburgh (Pa.) *Dispatch* says that the policemen in the adjoining city of Allegheny are busy buttonholing Councilmen about a grievance which they want remedied. The police are required to light the lamps and put them out before reporting off duty a 5 A.M. During the winter months that is an early hour to extinguish the lights, and the workingmen have to stumble along the dark streets to their shops. In order to save two hours' time before reporting for duty, the police are compelled to hire boys to do the lighting-up, and this costs the guardians of the peace about $15 per annum each. They believe this is unjust, and in order to have the streets illuminated until daylight, which cannot be done under the present system, they will solicit Councils to employ regular lamp lighters.

Where They Can be Seen in this Vicinity.—We are in receipt of the following letter from the main office (Newark, N. J.) of the Albo-Carbon Light Company: "We have pleasure in inclosing you a copy of our new catalogue, by which you will notice we are adding still more elaborate and fancy designs of our specialties especially suited for use in private residences and for church lighting. The inclosed list shows over 20 different styles of our lamps in every grade of elaborate and artistic finish. You are no doubt aware that Messrs. W. M. Crane & Co., our New York city agents, are located in the well-known 'Ye Olde London Streete' building, at No. 728 Broadway. These premises are lighted by our lamps. At the office of Messrs. Crane can be seen an extensive line of Albo-Carbon fixtures. They will, of course, be pleased to show the practical adaptation of our system in any way required." Those interested ought to write for a copy of the new catalogue, which readily explains itself.

Destroyed.—About three weeks ago the skewer factory of Swezey & Johnson, located in Painesville, Ohio, was destroyed by fire, and the machinery of the electric light company, which was housed in the same building, was badly wrecked. As the public lighting depended on the fractured apparatus, Painesville was relegated to darkness. It seems that by means of a blower the dust from the saws was blown into an adjacent room, close to the boilers, and used for fuel. This dust had been accumulating for several days, and to that accumulation was traced the explosion which preceded the fire. The loss is placed at $25 000.

To House the Plant.—Next spring the Meriden (Conn.) Gas Company will erect, on the old South Colony street site, a substantial brick building wherein to house its electric lighting plant.

Tumbled Down.—The pedestrians who happened to be passing along in the vicinity of Tenth street and Kansas avenue (Topeka, Kan.) at about dusk of Oct. 24, were treated to a novel, not to say startling, sight. This was nothing else than the collapse of a 150 feet in height tubular electric light tower, which had been erected by the city in 1880 or '81. The roof-tops in the vicinity of the "all" will need considerable attention at the hands of the roofers ere they can be called water-tight. The iron posts and braces were badly weakened, as investigation proved, although their outward appearance seemed to indicate soundness. Our informant says that the "city authorities recently entered into a contract with the local electric light company to erect a half dozen similar towers in different parts of the city, but the accident will in all probability cause the Common Council to annul the bargain."

Is There Room for Them?—A correspondent sends the following: "The people of Fort Wayne, Ind., are to be supplied with illuminating gas, at a cost not to exceed 75 cents per 1,000 cu. ft., by the Standard Gas, Fuel and Steam Company, which filed articles of incorporation with the Secretary of State on Oct. 28. The capital stock of the Company is fixed at $250,000, and the Directors are Messrs. J. R. Markle, J. P. Tillotson, W. S. O'Rourke, R. L. Roney, and S. Miller." These gentlemen are evidently inclined to promise great things; but how as to the performance thereof?

Public Lighting, Utica, N. Y.—The Council has awarded a contract for lighting the city of Utica to a concern known as the New York Electric Construction Company, supposed to be a branch of the Fort Wayne (Ind.) Jenney Electric Light Company. The contract, which is to run for three years, seems to us to be very loosely drawn. Under its provisions the contractors agree to light the city, in a manner satisfactory to the authorities, in consideration of an annual payment of $42,000. The lamps are to be kept in duty 27 nights each month, the duration of lighting to be fixed at an average of 10 hours per night.

[OFFICIAL REPORT.—Concluded from page 284.]

## Fifteenth Annual Meeting of the American Gas Light Association.

HELD AT DOCKSTADER'S HALL, NEW YORK CITY, OCT. 19, 20, AND 21.

SECOND DAY—MORNING SESSION—OCT. 20.

The President now introduced Mr. Emerson McMillin, of Columbus, Ohio, who read the following paper on

### FUEL GAS.

Some years ago one could seldom glance over the pages of any journal, and especially of those devoted to gas interests, without his eye falling upon the words "water gas." From about 1883 until recently, "natural gas" were the magnetic words. Now the absorbing theme seems to be "fuel gas." While water gas and natural gas are both fuel gases, still they do not seem to be the ideal gas in demand.

Water gas probably fails to meet the conception in the minds of the public of what a fuel gas should be—first, because it has not yet been offered to would-be consumers at prices that tend to bring it into general use; second, because water gas, pure and simple, possesses elements of danger, at least greater than that of illuminating gas made by any of the processes now in vogue; and, third, because of a strong prejudice, partly warranted by facts and partly cultivated (involuntarily in many instances) by many of us who are prone to belittle the merits and magnify the evil of things that we prefer should not succeed.

Natural gas fails to satisfy our wants as a fuel gas simply because where we look for it we generally fail to find it. We know that it can be had only in limited portions of our great country, and believe that it will be obtainable in these few favored localities for but a limited time.

If natural gas cannot be had, and water gas is considered in any sense undesirable, why not resort to illuminating gas for fuel?

"Too expensive" must be the answer. If anthracite coal or coke could be had in the Lima (Ohio) oil field at about $1 per ton, and used in connection with crude oil at present prices, a cheap and excellent illuminating fuel gas could be made. Pittsburgh, located on the margin of the Youghiogheny coal basin, should be able to make a good and very cheap fuel gas. Whether fuel gas can be made cheaply in any particular locality will depend largely upon the quantities in which it shall be produced. If all our consumers would, with one accord, agree to use illuminating gas to the exclusion of all other kinds of fuel, I think most of us could reduce our prices 25 to 50 per cent. from those now prevailing. But the consumers will not all agree, nor any great number of them, to do this; and therefore the gas companies are unable to make such startling reductions as above suggested.

When the writer first embarked in the gas business his employers were selling gas at $4 per thousand feet, and were unable to make a greater profit than was then considered a fair return on the investment. The consumers, of course, thought the price too high—as they always do; but we said to them that if more people would burn gas, and all who did burn it would do so to the exclusion of other modes of lighting, we would sell the gas cheaper. Most of you have probably used the same argument, and also received about the same answer—viz., "If the gas company would reduce their price we would burn more gas and many more would use it." In this the consumers were right—as they *sometimes* are. Twenty years later we find ourselves using the same argument and receiving the same answer respecting the sale and use of fuel gas. But the gas fraternity will profit by the 20 years and more of experience, and you will, if I mistake not, soon find gas companies launching out into the business of manufacturing fuel gas that will be sold at prices ranging from 25 to 40 cents per thousand feet.

Do not understand that I believe illuminating gas can soon be sold even at the maximum price named; but a gas that will meet the requirements of a fuel gas will be sold much below the maximum figure.

Good illuminating gas has been sold on some streets in a neighboring city at as low a figure as 35 cents per thousand feet, and I believe the gas has not been extensively used for fuel—other than for culinary purposes; but this fact is doubtless largely due to a conviction in the minds of the people that the low prices were but temporary, and liable to be terminated at any day.

Good illuminating gas, of whatever make, would be as cheap a fuel at $1 per thousand feet as would uncarburetted water gas at 50 cents per thousand feet. Yet it is quite probable that if the public could have immunity from danger, real or fancied, they would take much more readily to the use of the latter than to that of the former; such would be the magic effect of low prices.

The relative calorific values of the various gases now in use for heating and illumination have been frequently published, yet in the discussion of this subject we cannot well avoid a reproduction of some of the figures. Notwithstanding the fact that tables of this character have been so often published, we are all more or less confused occasionally by seeing statements made that make the comparison totally different from our preconceived ideas as to their relative calorific value. This confusion occurs from the fact that at one time we see the comparison of the gases made by weight, and at another time the comparison is made by volume.

We present here the comparison made both by weight and by volume, and shall use natural gas as the unit of value in both comparisons:

TABLE I.—*Relative Values.*

| | By Weight. | By Volume. |
|---|---|---|
| Natural gas | 1000 | 1000 |
| Coal gas | 949 | 666 |
| Water gas | 292 | 292 |
| Producer gas | 76.5 | 130 |

The water gas rated in the above table, as you will understand, is the gas obtained in the decomposition of steam by incandescent carbon, and does not attempt to fix the calorific value of illuminating water gas—which may be carburetted so as to exceed, when compared by volume, the value of coal gas.

You will observe in the table of values given above that one pound of coal gas is almost equal to a pound of natural gas, while 1,000 *feet* of coal gas has but two-thirds the value of a like quantity of natural gas. The relative values of water gas and natural gas are the same whether compared by weight or by volume. This is due to the fact that they possess the same specific gravity.

TABLE II.—*Composition of Gases.*—Volume.

| | Natural Gas. | Coal Gas. | Water Gas. | Producer Gas. |
|---|---|---|---|---|
| Hydrogen | 2.18 | 46.00 | 45.00 | 6.00 |
| Marsh gas | 92.60 | 40.00 | 2.00 | 3.00 |
| Carbonic oxide | 0.50 | 6.00 | 45.00 | 23.50 |
| Olefiant gas | 0.31 | 4.00 | 0.00 | 0.00 |
| Carbonic acid | 0.26 | 0.50 | 4.00 | 1.50 |
| Nitrogen | 3.61 | 1.50 | 2.00 | 65.00 |
| Oxygen | 0.34 | 0.50 | 0.50 | 0.00 |
| Water vapor | 0.00 | 1.50 | 1.50 | 1.00 |
| Sulphydric acid | 0.20 | .... | .. | .... |
| | 100.00 | 100.00 | 100.00 | 100.00 |

TABLE III.—*Composition of Gases.*—Weight.

| | Natural Gas. | Coal Gas. | Water Gas. | Producer Gas. |
|---|---|---|---|---|
| Hydrogen | 0.268 | 8.21 | 5.431 | 0.458 |
| Marsh gas | 90.383 | 57.20 | 1.931 | 1.831 |
| Carbonic oxide | 0.857 | 15.02 | 76.041 | 25.095 |
| Olefiant gas | 0.531 | 10.01 | 0.000 | 0.000 |
| Carbonic acid | 0.700 | 1.97 | 10.622 | 2.517 |
| Nitrogen | 6.178 | 3.75 | 3.380 | 69.413 |
| Oxygen | 0.666 | 1.43 | 0.965 | 0.000 |
| Water vapor | 0.000 | 2.41 | 1.630 | 0.686 |
| Sulphydric acid | 0.417 | .... | .... | .... |
| | 100.000 | 100.00 | 100.000 | 100.000 |

Some explanation of these analyses is necessary. The natural gas is that of Findlay, Ohio. The coal gas is probably an average sample of coal gas, *purified* for use as an illuminant. The water gas is that of a sample of gas made for heating, and consequently *not purified*, hence the larger per cent. of $CO_2$ that it contains.

Since calculating the tables used in this paper I am satisfied that the sample of water gas is not an average one. The CO is too high and H is too low. Were proper corrections made in this respect it would increase the value in heat units of a pound, but not materially change the value when volume is considered, and as that is the way in which gases are sold, the tables will not be recalculated.

The producer gas is that of an average sample of the Pennsylvania Steel Wo ks, made from anthracite, and is not of so high grade as would be that made from soft coal.

The natural gas excels, as shown in Table I, because of the large per cent. of marsh gas. In no other form in the gases mentioned do we get so much hydrogen in a given volume of gas. It is the large per cent. of hydrogen in the coal gas that makes it so nearly equivalent to the natural gas in a given *weight*, but much of the hydrogen in coal gas being free, makes it fall far short of natural gas in calorific value per unit of *volume*.

Water gas is composed, as you know, chiefly of carbonic oxide and hydrogen, both good heating gases, but nearly all the hydrogen being free, makes the actual weight of hydrogen in a given volume fall below that of natural gas; and again you will notice by the analysis given that three-quarters of the weight of water gas is CO, and of this compound four-sevenths is oxy-

gen, which possesses no calorific value; in other words, more than 40 per cent. of the weight of uncarburetted water gas, even when free from $CO_2$ and nitrogen, fails to add anything to the value of the gas as a heat producer. The producer gas, of which an analysis is given above, does not possess as high calorific value as it would if made from soft coal, but a greater volume can be made from a ton of anthracite or hard coke than can be made from a like quantity of bituminous coal.

A further comparison of the value of the several gases named may be made by showing the quantity of water that would be evaporated by one thousand feet of each kind of gas, allowing an excess of 20 per cent. of air, and permitting the resultant gases to escape at a temperature of 500°. This sort of comparison probably has more practical value than either of the others that have been previously given. We will assume that the air for combustion is entering at a temperature of 60°.

TABLE IV.—*Water Evaporation.*

| | Natural gas. | Coal gas. | Water gas. | Producer gas. |
|---|---|---|---|---|
| Cubic feet gas..... | 1,000 | 1,000 | 1,000 | 1,000 |
| Pounds water..... | 893 | 591 | 262 | 115 |

The theoretical temperature that may be produced by these several gases does not differ greatly as between the three first named. The producer gas falls about 25 per cent. below the others, giving a temperature of only 3,441° F. Water gas leads in this respect with a temperature of 4,850°. A formula for calculating the temperatures theoretically obtained may be as follows:

$$T = \frac{U + H}{W S}, \text{ where}$$

T = Temperature obtained.
U = Units of heat from combustion.
H = Heat units carried in by air.
W = Weight of resultant gases.
S = Specific heat of resultant gases.

A comparison of the resultant products of combustion also shows water gas to possess merit over either natural or coal gas, when the combustion of equal quantities, say, 1,000 feet, is considered. An excess of 20 per cent. of air is calculated in the following table:

TABLE V.—*Resultant Gases of Combustion.*

| Quantity—1,000 feet. | Natural Gas. | Coal Gas. | Water Gas. | Producer Gas. |
|---|---|---|---|---|
| Weight of gas before combustion, lbs..... | 45.60 | 32.00 | 45.60 | 77.50 |
| Steam..... | 94.25 | 69.718 | 25.104 | 6.921 |
| Carbonic acid..... | 119.59 | 68.586 | 61.754 | 36.456 |
| Sulphuric acid..... | 00.36 | ..... | ..... | ..... |
| Nitrogen..... | 664.96 | 427.222 | 170.958 | 126.568 |
| Total w'ght after combust'n | 879.16 | 565.526 | 257.816 | 165.945 |
| Lbs. oxyg'n for combinat'n | 167.462 | 107.961 | 43.149 | 19.677 |

While the combustion of 1,000 feet of natural gas vitiates the atmosphere, when consumed under the conditions named, more than five times as much as does the combustion of 1,000 feet of producer gas, yet for the work performed the former vitiates the atmosphere less than does the latter gas.

You will observe by the following table that, with the exception of producer gas, each kind gives off nearly one pound of waste gases for each pound of water evaporated. This quantity includes 20 per cent. excess of air.

TABLE VI.—*Weights of Water Evaporated and of Resultant Gases.*

| | Natural Gas. | Coal Gas. | Water Gas. | Producer Gas. |
|---|---|---|---|---|
| Weight water evaporated.. | 893.25 | 591. | 262. | 115.1 |
| " gases after combust'n | 879.16 | 565.526 | 257.816 | 169.945 |

The vitiation of the atmosphere per unit of value in water evaporation is precisely the same in water gas as in natural gas. Coal gas shows about 3 per cent. better than either of the two gases named in this respect, and about 50 per cent. better than producer gas.

In the above comparisons all of the resulting products of combustion, including excess of oxygen, are regarded as being of a deleterious character, tending to vitiate the atmosphere. However, the excess of oxygen does no harm, and the steam and nitrogen cannot be regarded as very objectionable products. The gas that robs the air *permanently* of the most oxygen, and produces the greatest quantity of carbonic acid per unit of work, must be classed as the most objectionable from a sanitary standpoint.

TABLE VII.—*Oxygen Absorbed and Carbonic Acid Produced.*

| In Combustion. | Natural Gas. | Coal Gas. | Water Gas. | Producer Gas. |
|---|---|---|---|---|
| Pounds of oxygen absorbed per 100 lbs. water evap'ed.. | 18.75 | 18.27 | 16.47 | 17.96 |
| Pounds of $CO_2$ produced per 100 lbs. water evaporated.. | 13.40 | 11.60 | 23.57 | 31.70 |
| Oxygen absorbed plus $CO_2$ produced..... | 32.15 | 29.87 | 40.04 | 49.66 |

Here, then, it is shown that if pollution by carbonic acid, and impoverishment by the absorption of oxygen, are equally deleterious to the atmosphere, coal gas stands at the head as being the least objectionable.

It will be conceded that the gas that gives the greatest number of heat units for a given volume, with the least weight of resultant gases of combustion, must possess the greatest value for all ordinary purposes of heating. Notwithstanding this fact there are purposes for which gas is used where this rule would not apply. For instance: Natural gas is not so desirable for gas engines as is coal gas, chiefly because the flame that lights the explosive mixture is too easily extinguished; again, the explosive mixture will not ignite so readily where natural gas is used as it will when coal gas or water gas is used.

For metallurgical purposes the producer gas has one advantage over all other gases in this, that it contains less hydrogen in any and every form than either of the others; and where metal, and especially iron or steel, is to be heated to very high temperatures by direct contact, it is questionable if anything like the full value of the hydrogen is utilized, unless it be combined with oxygen in recuperators and returned in the air used for secondary combustion. While this advantage does not bring producer gas nearly up to the value of any of the other gases, yet it does bring its value nearer to the others than appears from a theoretical calculation.

The producer gas, on the other hand, possesses a disadvantage in connection with metallurgical work in this, that the resultant gases having to pass off at high temperatures, and the weight of these per unit of work being so much greater than that of the other gases, more heat units will thus be wasted. This disadvantage, however, will not be very great where recuperators are employed, nor will it be great when the gas is used for raising steam, or for culinary purposes, or for any purpose which permits the waste gas to finally escape at a low degree of temperature.

In the utilization of coal gas for fuel we do not obtain, even theoretically, much more than 25 per cent. of the energy of the coal from which the gas was made; but this is not a fair way to put it, because we have in the coal gas manufacture the valuable residuals, coke, tar and ammonia. It will only be convenient to compare the processes for the manufacture of two of the gases—water gas and producer gas—and ascertain in which the greater loss of energy is sustained. In making these comparisons we must accept data obtained from practice rather than what might be deduced by theoretical calculation. It would be difficult to calculate what quantity of energy would be wasted in blowing up a heat in a water gas apparatus. We might tell how much heat would be lost in the generation of the steam required if we knew exactly how much of the steam was decomposed. But upon this point there is a great diversity of opinion, some claiming that 90 per cent. is decomposed, while others claim that not more than 25 to 40 per cent. is utilized in the cupolas.

The net results obtained from fuel by the many different works using water gas apparatus vary greatly, doubtless because of the varied conditions under which they are operated. In some works the cupola may run almost constantly, and there the minimum quantity of hard fuel will be required. In smaller works the cupolas will be idle half the time, and there the maximum quantity will be used.

After consultation with a number of the best authorities, and with those of the largest experience, I conclude that about 35 pounds of hard coal or coke is required in the generation of 1,000 feet of water gas for illuminating purposes. But only about two-thirds (or 667 feet) of this is made from the coal and steam, the other third coming from the oil used for enriching. If this be true, then, on that basis, it would require 52 pounds of coke or hard coal to produce 1,000 feet of water gas without the aid of oil.

That, however, is an unfair way to rate it. A large quantity of fuel must be used to vaporize and fix the oil gas, and where oil is not used this fuel may be converted into gas. Here, then, I think we may cut down the fuel required per 1,000 feet from 52 to 42 pounds.

The most accurate trial of which I have obtained a record shows, on a months's run, an average of about 8.75 pounds of coke required for the generation of steam for each 1,000 feet of gas made—and this when using oil; it will of course take more steam when oil is not used. We will increase the steam fuel, then, from 8.75 to 10 pounds, giving total required 52 pounds. But if gas is being made for fuel porposes it is probable that the apparatus would be operated more nearly continuous than it would be in making illuminating gas, and this would tend to a reduction of fuel requirements. We may safely say, then, that not more than 50 pounds of coal or coke would be required in the production of 1,000 feet of fuel water gas. The energy of one pound of hard coal or coke ought to equal 13,000 heat units, but we will rate it at 12,500 units. Then 12,500 multiplied by 50 pounds equals 625,000 units, which represents the energy expended in the production of 1,000 feet of water gas. We obtain from or by the combustion of the gas but 322,346 units.

In the production of producer gas we need not be at a loss as to the energy required to be expended, as it is represented simply by the difference be-

tween the energy of the coal used and of the gas produced—the coal in the producer furnishing its own heat. There will be about 5.85 *pounds* of gas made for each pound of hard coal or coke charged if no steam is used, which is seldom the case—the weight decreasing with the increased use of steam. If 5.85 *pounds* of gas is made for each pound of fuel charged, then there will be 13.25 pounds of fuel used for each 1,000 feet of gas made. This is equal to about 150,000 feet per ton of 2,000 pounds.

The heat generated in the manufacture of this producer gas would much more than be sufficient to generate the steam that could be advantageously used in blowing air into the producers, so that no fuel is lost there.

Then we have the quantity of gas made in each instance from a ton of coal as follows :

TABLE VIII.—*From* 2,000 *Pounds of Coal.*

| | Water Gas. | Producer Gas. |
|---|---|---|
| Quantity | 40,000 ft. | 150,000 ft. |
| Heat units | 12,893,840 | 17,468,975 |
| Per cent. of the total value of coal | 51.9 | 68.8 |

In determining the quantity and value of producer gas I have assumed that in a ton (of 2,000 pounds) of hard coal there are 1,750 pounds of carbon, the calorific value of which would be 25,375,000 units. Now, if we convert this carbon to CO there must be a loss of (1,750 × 4,325, or) 7,568,750 units, and this deducted from 25,375,000 leaves 17,806,250 units, instead of 17,468,975 units as given in the table above. This difference is due to using 4,325 as the figures that represent the units of heat produced by burning one pound of carbon to CO, and also for representing the heat units generated in burning a pound of CO to carbonic acid.

In calculating the energy derived from the coal used in the producer furnace we have assumed that the carbon consumed was converted to CO by oxygen from air, and that there was no hydrogen present. This is never the case, however, as there is always some hydrogen in the coal, and some moisture both in the coal and in the air admitted. The hydrogen thus admitted from these sources, as well as that blown in if a steam jet is used, tends to decrease the quantity of gas produced, and to increase the calorific value of a unit of weight, but does not materially change the theoretic value of the total product. The quantity is decreased in the use of steam by diminishing the quantity of nitrogen that would otherwise be admitted with the oxygen of the air.

If the producer gas is made without the introduction of steam or hydrogen in any form, it will have a value of but 117,315 units per 1,000 feet instead of 143,375, the value given to the gas of which the composition is shown in Tables II. and III.

Natural gas cannot be had for general use; coal gas is too expensive; uncarburetted water gas is expensive, and a prejudice exists against its use; producer gas, while it can be very cheaply made, is bulky, and requires a high temperature for ignition. None of these several gases taken alone seems to meet the requirements of a good and cheap fuel gas.

That a cheap fuel gas is in demand is a fact that will not be questioned, and that this demand can and must be met we all believe. How, then, shall the gas be supplied so as to make its use the most effective, the safest, and the most popular, and at the same time with the least expenditure of capital on the part of existing gas companies, is, to my mind, the problem to be solved.

In order to use plants now erected, and to give *heating* power as well as to impart *odor* to the product, I would make part coal gas; in order to work up the coke from coal gas benches, and greatly cheapen the final product, I would make part producer gas; and in order to keep up the calorific value of the gas, which would be too low if all the coke from coal gas was converted into producer gas, I would make part water gas.

I would so proportion these several kinds of manufactured gas that the final product would have about the calorific value of water gas. I would do this, not specially because it would be more advantageous to the consumer to pay 40 cents for gas that contains 350,000 units of heat than it would be to pay 80 cents for gas that contains 700,000 units; neither would I supply that character of gas wholly because it would cost less per unit of heat to the manufacturer of the gas; but chiefly because the less the price is per thousand feet—the price per unit of heat being the same in each instance—the more gas will be sold.

If it be a fact that fuel gas must be sold at a low price to induce the public to generally adopt gas heating and cooking in lieu of solid fuel—without much reference to comparative values—then it appears to me that uncarburetted water gas is about the only product now being offered to the public with any reasonable prospect of being received with favor.

Now if we can, by a mixture of these several gases, obtain a product of equal value with water gas as a heat producer, at less cost, we will be taking a step forward.

Let us, then, base our estimates on what may be obtained from one ton (2,000 pounds) of bituminous coal, equal in quality to that obtained in the Youghiogheny coal field of Pennsylvania, one pound of which has a calorific value of, say, 13,500 units.

This ton of coal would produce 10,000 feet of gas, 1,300 pounds of coke, 120 pounds of tar, 120 pounds of ammoniacal liquor, leaving 110 pounds to cover loss of manipulation. The tar may be converted into 500 feet of gas, leaving 100 pounds of residual (of which no further notice is taken), making the total quantity 10,500 feet. The tar at present could be sold with greater profit as tar, but should the manufacture of gas fuel become general the market for tar would soon be over supplied. Of the 1,300 pounds of coke about 300 pounds would be used in heating coal gas retorts. It can easily be shown that the waste heat of the gases from the coal gas furnaces, together with the heat of the gas from the producer, will be much more than sufficient to raise the steam required for the production of the proportion of water gas that is to be made, and still let the furnace gases escape to tall stacks at a temperature in excess of 500°.

The water gas and producer cupolas should be so located that the hot coke could be dumped (if not drawn) into them from the retorts. In this way we would introduce heat with the coke from each ton of coal more than equal to that required for the production of 1,000 feet of water gas. There can be no reasonable doubt, I think, of the possibility of making water gas in this way with very much less expenditure of fuel than is now required. But to be safe we shall only estimate the production at the rate of 50,000 feet from 2,000 pounds of fuel.

We will introduce 500 pounds of the coke into the water gas cupola, and the remaining 500 pounds into the producer furnace. From the water gas apparatus we will obtain 12,500 feet of gas, and from the producer 36,800 feet. These quantities added to the 10,500 feet of coal gas makes a total of 59,800 cubic feet, with a calorific value of 17,160,258 units, which equals 63.5 per cent. of the energy of the coal. Considering the character of the gas, the quantity produced by 2,000 pounds of fuel seems small.

It may be well to notice how the quantities of water gas and producer gas were or could be obtained. In putting 500 pounds coke hot from gas retorts into cupolas you will introduce about 220,000 heat units—thus, 500 × 2,000 × .22 = 220,000. Having the benefit of this heat, and not requiring any of the solid fuel to be used in the generation of steam for water gas, our estimate of 25 feet to the pound will not be excessive. 25 × 500 = 12,500 feet water gas.

We will go more into detail respecting the production of producer gas, as perhaps all of you are not so familiar with its manufacture. In the 500 pounds of coke to be used we will have 440 pounds of carbon. By reason of imperfect working of the furnace we must assume that we will get some carbonic acid. This gas is generally made in the producer when there is an excess of steam, low heats, or by the gases escaping through channels in the fuel. We will assume, therefore, that 40 pounds of the carbon is converted into carbonic acid. This gives a little larger per cent. than is previously shown by analysis.

This leaves 400 pounds of carbon of the 500 pounds coke introduced. Of this quantity we will use 133.3 pounds in the decomposition of 200 pounds of steam into H and CO, and the remaining 266.7 pounds carbon will be converted to CO by oxygen from the air. In this manipulation we have a heat production as follows:

| | |
|---|---|
| From hot coke 500 lbs. × 2,000 × .22 | 220,000 |
| " 40 lbs. carbon (to $CO_2$) × 14,500 | 580,000 |
| " 400 lbs. " (to CO) × 4,325 | 1,730,000 |
| Total heat units | 2,530,000 |

This takes no note of heat carried in by steam.

Heat expenditures will be about as follows:

| | | |
|---|---|---|
| By radiation and convection | 253,000 | |
| In the decomposition of 200 lbs. steam (=22.22 lbs. hydrogen × 62,000 =) | 1,377,640 | |
| Absorbed by heating from 250° to 1,250° 50 lbs. steam that will probably escape decomposition 50 × 1,000 × .475 = | 23,750 | |
| Total heat units expended | | 1,654,390 |
| Units of heat remaining | | 875,610 |

With this quantity of heat will we have sufficient intensity for the decomposition of steam? Experience says yes; but to determine this theoretically we must first ascertain the composition and the specific heat of gases.

TABLE IX.—*Specific Heat of Gases.*

| | | | |
|---|---|---|---|
| Carbonic acid | 146.67 × | .2164 | = 37.74 |
| Carbonic oxide | 933.34 × | .248 | = 231.47 |
| Nitrogen | 1,525.35 × | .244 | = 37.218 |
| Hydrogen | 22.22 × | 3.400 | = 75.55 |
| | 2,627.58 | | 716.94 |

$\frac{716.94}{2627.58} = .273$, or the average specific heat. Then $\frac{875,610}{2627.58 \times .273} = 1221°$ of temperature.

With free escape from the producer it is not probable that the gases would take up the temperature of the fuel. Experience has shown that the gases escape at a temperature of 750° to 900°. If the gases shall escape at a temperature of 1,000°, then an equal weight of the fuel would be increased.

$\frac{221 \times .273}{.220} = 274°$; and this added to the 1,221° would give the temperature of 1,495°. The gas made in the producer would be about as follows:

TABLE X.—*Composition, Quantity and Value of Producer Gas.*

| Gas. | Weight. | Cu. Ft. | Units. |
|---|---|---|---|
| CO | 933.34 | 12,000 | 4,036,695 |
| H | 22.22 | 4,000 | 1,377,640 |
| $CO_2$ | 146.67 | 1,200 | |
| N | 1,525.35 | 19,600 | |
| | 2,627.58 | 36,800 | 5,414,335 |

Then we have the mixture of the three products in the proportions given below:

TABLE XI.—*Composition, Quantity and Value of Mixed Gases.*

| Product. | Quantity, Ft. | | Value per M. | | Total Heat Units. |
|---|---|---|---|---|---|
| Coal gas | 10,500 | × | 734,976 | = | 7,717,248 |
| Water gas | 12,500 | × | 322,346 | = | 4,029,330 |
| Producer | 36,800 | × | 147,084 | = | 5,412,692 |
| | 59,800 | × | 287,000 | = | 17,159,270 |

$\frac{287,000}{322,346} = .89$. It thus appears that 1,000 feet of this mixture has but 89 per cent. of the value of water gas. The heat units per thousand can only be increased at the expense of reduction in total quantity. The results obtained are not so good as we ought to have. What part of the process has failed to do good work? Let us see.

With 16.8 per cent. of the weight of coal in the coal gas, it gives 28.58 per cent. of the total heat units possible from the coal. With 25 per cent. of the weight of coal used in the production of the producer gas, it gives 20 per cent. of the energy of the coal. With 25 per cent. of the weight of the coal used in the production of the water gas, it gives but 14.92 per cent. of the energy of the coal in heat units.

Here, then, it is clearly shown that the fault lies in the low results obtained from the fuel converted into water gas.

I believe that 25 feet is about all that will, in practice, be obtained from a pound of coke or hard coal with generators as now constructed; but we ought to get better results. Notwithstanding the fact that the water gas gives us poorer net results than either of the other processes, if we are to increase the calorific value of the mixed gas it must be done by decreasing the producer and increasing the proportion of the water gas product.

We will note what the result would have been had the ton of coal been differently treated.

Had the carbon of the coke from the ton of coal been treated in water gas apparatus alone, the quantity would then have been 10,500 feet coal gas plus 20,000 feet water gas, or a total of 30,500 feet, with a total calorific value of 14,164,168 units, which would equal but 52.46 per cent. of the energy of the coal.

In practice, then, the results obtained are about as follows:

From a ton of hard coal in water gas apparatus we get 40,000 feet and 51.9 per cent. of energy. From same quantity hard coal in producer furnace we get 150,000 feet and 68.8 per cent. of energy.

From ton of gas coal, when all the surplus coke is treated in water gas apparatus, we get 30,500 feet and 52.46 per cent. of energy.

From same quantity of soft coal, with half of surplus coke converted to water gas and half to producer gas, we obtain 59,800 feet of gas and 63.5 per cent. of energy.

From a ton of gas coal, converting all the surplus coke to producer gas, we will obtain 84,500 feet of gas and 64.98 per cent. of the energy of the coal.

Producer gas alone cannot be used for domestic purposes. Nor do I think it would be safe to use so large a per cent. of producer gas as can be made from the surplus coke of a ton of gas coal. It would not easily ignite, and under certain conditions might become extinguished without having the supply cut off, and it would therefore be dangerous to use so large a per cent. of it.

Now, had the ton of soft coal been converted directly into water gas, making permanent gas out of the volatile hydrocarbons, we *possibly* would have obtained as large a per cent. of the value of the coal as would be obtained by first retorting the coal, though this may be questioned; but in passing the volatile hydrocarbons down through incandescent coke in the presence of steam we would, in a large measure if not entirely, break up the compounds of the olefiant gas series, to which the odor of coal gas is so largely due, and would also form compounds of less calorific value—that is, the carbon would be largely taken from the hydrocarbon compounds and converted into carbonic oxide.

To give the mixed product as high a value in heat units per 1,000 feet as water gas contains, we must change the proportions somewhat, and use 667 pounds of the coke in water gas apparatus, and but 333 pounds of the coke in the producer furnace. Then we will have the proportions and values shown in following table:

TABLE XII.—*Mixed Gas.*

| Product. | Quantity, Ft. | Value per M. | Total Units. |
|---|---|---|---|
| Coal gas | 10,500 | 734,976 | 8,717,248 |
| Water gas | 16,600 | 322,346 | 5,351,944 |
| Producer gas | 24,500 | 147,084 | 3,603,558 |
| | 51,600 | 323,115 | 16,672,740 |

In per cent.—Coal gas, 20.35; water gas, 32.17; producer gas, 47.48.

By thus changing the proportions we reduce the total quantity in feet by 8,200, and total heat units by 486,530; but the mixture has been increased in value from 287,000 to 323,115 units per 1,000 feet, or to a value that is a fraction better than water gas, while the quantity of gas is 29 per cent. more than we have estimated that 2,000 pounds hard coal or coke would produce of water gas alone.

Having now ascertained the quantity of gas that can be produced from a ton of gas coal, and of a quality that we believe will be desirable, it is necessary to know the cost of same.

TABLE XIII.—*Estimated Cost in Holder.*

| | Coal Gas. | | Water Gas. | | Producer Gas. |
|---|---|---|---|---|---|
| Labor | 12c. | | 5.5c. | | 1c. |
| Repairs and incidentals | 3c. | | 1.5c. | | 0.25c. |
| | 15c. | | 7.0c. | | 1.25c. |
| Coal gas | 10,500 | × | 15c. | = | $1.575 |
| Water gas | 16,600 | × | 7c. | = | 1.162 |
| Producer gas | 24,500 | × | 1.25c. | = | .306 |
| | 51,600 | | | | $2.043 |

$\frac{2.043}{51,600} = 3.961$, or about 4 cents per 1,000 feet. If the coal costs $2 per net ton this item of fuel will add 3.88 cents; and if it costs $3 it will add 5.72 cents; and if coal costs $4 per net ton it will add 7.75 cents—making gas cost, per 1,000 feet in holder, 7.88 cents, 9.72 cents, and 11.75 cents respectively.

Do these prices appear very low? They are not only obtainable, but I believe even better results may be had. I may add that the wages item is intended to cover superintendence.

Here we may note some features that to my mind are interesting—that is, the cost of various gases per million units of heat of which they are theoretically capable of producing.

In working out these figures I put wages, repairs, and incidentals, as given in last table, and the cost of a ton of good gas coal at $2, and a ton of hard coal or coke at same price, and the quantities of production as follows: Coal gas from soft coal 10,000 feet; water gas from hard coal 40,000 feet; and producer gas 150,000 feet.

TABLE XIV.—*Cost per Million Units of Heat.*

| | | | | |
|---|---|---|---|---|
| Coal gas | 734,976 | units at | 20c. | = 27.21c. |
| Water gas | 322,346 | " | 10.88c. | = 33.75c. |
| Producer gas | 117,000 | " | 2.58c. | = 22.05c. |
| The mixture | 323,115 | " | 7.88c. | = 24.39c. |

Thus it will be seen that, after all, coal gas costs but 11.6 per cent. more per unit of heat than the mixture we have worked out. While water gas, per unit of heat, costs 38.38 per cent. more than the mixed product. In arriving at these ratios of cost I speak from knowledge respecting cost of coal gas, and from the testimony of the producers of water gas respecting cost of that product.

If 2,000 pounds of good hard coal or coke can be made to generate the necessary steam and produce 50,000 feet of gas, then upon that basis the cost per million units will be 26.8, or a little lower than coal gas; but this assumes that the wages and repairs would be no greater in producing 50,000 feet than in the production of 40,000 feet—a basis of figuring hardly fair to coal gas.

The mixed gases would have the following composition:

TABLE XV.—*Analysis of Fuel Gas.*

| | |
|---|---|
| Hydrogen | 29.00 per cent. |
| Marsh gas | 8.78 " |
| Carbonic oxide | 31.18 " |
| Olefiant gas | 0.81 " |
| Carbonic acid | 2.94 " |
| Nitrogen | 26.24 " |
| Oxygen | 0.26 " |
| Water vapor | 0.79 " |
| | 100.00 |

The specific gravity is 0.683, and 1,000 feet will weigh about 54.6 pounds. Gas of this gravity will require greater pressure to force it through pipes of given diameter than would be required for either coal gas or water gas. If 2 inches water column pressure is required for the delivery of a definite quantity of coal gas, then 2.4 inches would be required for water gas, and 2.6 inches would be required with the fuel gas, for the delivery of equal quantities through same length and diameter of pipe.

Having decided on the kind of gas that will be the most satisfactory—all things considered—and also determined the cost per 1,000 feet for manufacture, it remains now for us to find a market. In a city of 100,000 inhabitants there will be used for fuel, other than for manufacturing, not less than 200,000 tons of coal per year. Gas mains will ordinarily pass the localities where three-fourths of the total quantity of coal would be consumed; but to be within bounds we will assume you can, without more miles of mains than are now in use, substitute with gas fuel one-half, or 100,000 tons of the coal. What quantity of gas will be required to make this substitution? It will require 80,000 feet of our gas to equal in theoretical value one ton (2,000 pounds) of coal. But it is well known to all that not 10 per cent., if indeed 5 per cent. of theoretical value of the coal is utilized in domestic heating.

We will be very liberal and base our calculations on the larger utilization. This, then, brings the coal down to the value of 8,000 feet of gas, provided the full value of the gas can be obtained in practice. But this cannot be done. With proper facilities 75 per cent. of its value might be utilized, but we will put it at only 50 per cent. Then we have 16,000 feet of gas as the equivalent in practice to 2,000 pounds of coal.

We will assume the price of coal at $3. This price divided by 16 gives a value to the gas of 18.75 cents per thousand. You may, I think, safely add 6.25 cents to that price for the saving in kindling, handling of ashes, and general cleanliness, making value of gas 25 cents per 1,000 feet.

If it requires 16,000 feet of gas to substitute one ton of coal, it will require 1,600,000,000 feet to substitute 100,000 tons of coal. This will require a daily production of about 4,400,000 feet varying in quantity probably from 3,000,000 minimum in summer to 7,000,000 maximum in winter. The capital required would be very much less per 1,000 feet output than is required in the manufacture of illuminating gas. The distributing portion of the plant would not cost more than one-half, and the manufacturing part not more than one-fourth that required for a coal gas illuminating plant.

Upon this basis an investment of $2,500,000 should be sufficient. If the gas costs, including repairs, 10 cents in holder, it will cost when sold and collections made, 15 cents per 1,000 feet. Then, selling 1,600,000,000 feet at a profit of 10 cents nets $160,000. Six per cent. on estimated investment equals $150,000. Thus it will be seen that if you want 10 per cent. on your investment you will have to sell gas at about 30 cents per 1,000 feet.

You will observe that in the estimate of cost of coal that each dollar of the price per ton equals 2 cents per 1,000 feet on the cost of gas; therefore, to arrive at the cost of gas in localities where coal is above or below $3 per net ton, additions or subtractions will be made to the estimated cost of 10 cents per 1,000 feet of one cent for each 50 cents variation in price of coal. The margin for profit deduced is not large. However, it will be borne in mind that I gave a value to coal very much above actual results obtained, and placed the value of the gas below where all authorities put it. By a proper adjustment of the value of the two fuels a fair profit may be figured ont. I do not believe the gas can be greatly reduced in cost of manufacture below these estimates, nor that it can be sold much above 25 cents per thousand feet.

How this gas shall be consumed is an important problem. Of course, the best way would be to use all the gas in stoves, the way in which that applied to cooking will be used. It will, however, not be possible to induce all the public to substitute stoves for grates. But grates can be filled with refractory material of good radiating power, and the flues above the grates can be closed so as to leave but a very small opening, say that of one or two inches area, which will be sufficient to carry off the products of combustion, and at the same time confining, as it were, the hot gases until the heat shall be imparted to the air and walls of the room.

The total quantity of heat required to be generated for heating a room in this manner will be almost insignificant compared with that required to be generated when the flues have to be open to produce draft, and under which condition there is probably 40 to 50 tons of heated air carried up the chimney for every ton of coal consumed. The expense that would be incurred in preparing an ordinary grate for the economical use of gas would be very small.

Fewer hot air furnaces and fewer steam and hot water radiators would be used were gaseous firing in general use. But the gas could be adapted to these systems very readily by reducing the exit flues and filling furnace boxes with refractory material.

If we are to use our present plants for the manufacture and distribution of fuel gas, then what is to become of the present lighting system? There are two substitutes. First, there are two or three devices for incandescent gas lighting now struggling for recognition. It has not been the good fortune of the writer to see but one of these in use, and it did not impress him favorably; still it certainly gives more promise of future usefulness than did the incandescent electric light ten years ago. Should there be an incandescent gas burner invented or improved and made a success, then, of course, the problem will be solved. Again, it is proposed to substitute incandescent electric lights for the gas. There is nothing impracticable in this, if you can satisfy the consumer that it is to his interest to make the change from gas to electricity.

During the period of transition from gas to electric lighting one holder may be used for fuel gas; the gas from this to be led to a square or block already provided with incandescent lights. Here the gas main can be cut off from illuminating gas mains and attached to the fuel gas supply. Then the next square can be treated in the same way, until the entire system is changed without inconvenience to consumers. If it shall be found that there are districts supplied with gas which from any cause it would not pay to supply with electric light, those districts could still be supplied with illuminating gas with but slight change in the distributing lines.

Whether electric lighting has made such advancements as to warrant this substitution is a question that must be decided by others. However, from the hundreds of thousands of incandescent burners that we now know are in use we may be justified in asserting that the change is at least practicable.

But that either the incandescent gas burner or the incandescent electric burner should be substituted for gas light is not absolutely essential to the manufacture, sale, and use of fuel gas. Gas companies can and ought to manufacture fuel gas even if in doing so it becomes necessary to duplicate their present lines. The demand for fuel gas, like the demand for electric light, has come to stay. It will not down. Scientific investigators as well as the public insist that there ought to be and must be a change in the mode of domestic and industrial heating. Our present systems are not in keeping with the general progress of the nineteenth century.

In consideration of the powers, rights and franchises conferred on corporate gas companies by the public, these companies should endeavor, even at some financial risk, to solve the problem. But, aside from any moral obligation, as a matter of policy the gas companies should lead off in these investigations. If they do not do it you will, before long, find other companies asking for franchises and the right to tear up the streets. These companies will lack the experience now possessed by the old gas companies, and must work with less probability that success will crown their efforts.

Let the policy and practice of gas companies be such as shall discourage the duplication of capital. Where one capital can do the business, it is almost criminal to permit two to be invested.

*Discussion.*

Mr. A. C. Humphreys—Quite likely it is apparent to all of us that it is almost impossible to discuss such a paper as this without having the paper before us. I think that fact alone should force upon us at this meeting the necessity of having the papers recommended by the Executive Committee printed at least two weeks ahead of the meeting of the Association, so they may be sent in advance to the members for their study, to the end that we may be prepared to discuss them properly. Such is the practice in some of the engineering societies in this country, and I do not think we should be behind. I think every member of the Association who listened to this paper will feel that a vote of thanks will not repay Mr. McMillin's efforts. We ought individually to feel grateful to him for such a presentment of the subject, for I think it is the most important subject we have before us at this meeting. The questions of fuel gas and incandescent lighting run right together. We have heard in the Address by the President, as well as in some references by Mr. McMillin, something on the subject of incandescent lighting. Now, it is not my purpose to drag in any discussion on that point—in fact, as far as I am concerned, I would not be dragged into it; but, since the subject did come up, it is perhaps incumbent on me to say I know possitively that the experiments given do not cover all the ground. In fact, referring to the most prominent burner before you—the Welsbach—I will say we at least are perfectly willing to leave that without discussion, for we know what will be the result. There are one or two questions I would like to ask, for the better clearing up of the subject. In the figures given as to the relative evaporative powers of the gases, were there any experiments made, or was the result simply determined from calculation?

Mr. McMillin—The figures are the result of both. I think recorded experiments, generally speaking, will verify the data upon all such questions. These theoretical values are obtained from experiments in the first place; and any experiments that I have ever known to be made have usually verified those as closely as it would be possible for crude apparatus to so do.

Mr. A. C. Humphreys—Of course I make that inquiry, as Mr. McMillin knows, because (especially in the case of water gas) the statement has been made by metallurgical men that the theoretical value could not be arrived at. Does or does not Mr. McMillin think that the 20 per cent. air dilution could be greatly improved upon by the aid of improved devices?

Mr. McMillin—It would not materially change it. I put it at figures which should not be excelled in any event. Certainly one ought not to use more than 20 per cent. I will say, however, that in the neighborhood of Pittsburgh, although they use a great deal more than that, there is no necessity for it. But there is no object in economizing there, as they buy the gas for so much per ton of iron or steel.

Mr. A. C. Humphreys—You believe the methods now pursued in the consumption of natural gas are extremely crude?

Mr. McMillin—Yes.

Mr. A. C. Humphreys—In burning off the C after the CO—do you call that an entire loss? In other words, is there a partial combustion of coal in the generator?

Mr. McMillin—In calculating the value of it I take the gas after it leaves there, whatever that may be. If you were using that gas where you could utilize the heat generated at the time, you could then doubtless utilize a great deal of it, because you might get it in there at 500° or 600° of temperature. But if it must be cooled and put into holders, of course it would only have the value of CO afterward.

Mr. A. C. Humphreys—Then it is taken in the account that that partial combustion can be recovered to a greater or less extent?

Mr. McMillin—Yes.

Mr. A. C. Humphreys—With regard to the mixture of gas, I believe the final outcome will be that a mixture of coal gas with water gas will be made directly. In other words, we will be able to make water gas from soft coal. That there is a necessity for a gas, other than what we now call non-luminous water gas, is very apparent. It would not be safe, in my opinion; and I would be unwilling to recommend the distribution of uncarburetted water gas, simply because we are unable to detect its presence. But I do not regard that as being at all out of the way. I do not think we should be discouraged in that direction, as we can easily impart an odor to the gas. I think it will be done by making water gas from soft coal—in other words, that there will be a union, finally, of the water and the coal gas men.

Mr. McMillin—I want to add I heartily agree with Mr. Humphreys upon that point. Notwithstanding the fact that, if done at all, certainly not until recently has water gas been successfully manufactured from soft coal, I feel sure that eventually not only the coal gas but water gas and producer gas will all be made in the same vessel. There, to my mind, would be the greatest economy in the manufacture of producer gas, because you can decompose enough steam by the heat which would otherwise be wasted in the production of producer gas to a very considerable extent. I believe I showed in my paper, by the burning of 133 pounds you can decompose 200 pounds of steam; and it is possible you might go still further. Certainly there is no other way in which you can so economically utilize the heat that is made in the producer, in the burning of air and carbon to CO, as in converting steam into water gas. The three gas mixtures will, I think, eventually be made in that way. I think that is what we will all have to come to. It is a little hard for us coal gas fellows to feel that after a while we will be making our coal gas in a water gas apparatus; but still I think we will have to come to it.

Mr. Graeff—Do I understand you to say that water gas would be made from bituminous coal, or that it was being so made?

Mr. McMillin—I said it had not been successfully made—certainly not until recently. We hardly have time to investigate all the things as we go along. I believe Mr. Loomis has a process in use in Philadelphia, where he is using bituminous slag; and I have seen a notice to the effect that Prof. Lowe is lighting up Los Angeles, Cal., under a somewhat similar plan. These systems, of course, may not prove to be all that is desired; but it will come eventually, even if we have not got it now. There are several generators on the market, or struggling for recognition at the present time, with which it is proposed to use soft coal, right in the cupola. I can only wish them a hearty success.

The President—I entirely agree with Mr. Humphreys as to the value of the paper we have just had read. Certainly, all these papers which carry statistics ought to be printed before the meetings of the Association, and I think it is well worthy the attention of the Executive Committee to see that hereafter this shall be done; but it would be pretty hard to require that they shall be sent two weeks in advance of the meeting of the Association, as most men who write papers find it impossible to prepare them until the last moment—or at any rate, which amounts to the same thing, they are apt to postpone their preparation until that time. I would like to say something in reply to what Mr. Humphreys said in regard to the suggestion of Mr. McMillin, as well as that made by myself, in the matter of incandescent gas burners. You will find, in reading what I have said, that I carefully qualified my remarks; and so has Mr. McMillin. I suggested that, in my opinion, incandescent gas burners, although not in every way desirable at the present time, still are shown to be much further advanced than were the electricians 15 years ago. As to the incandescent burners heretofore put upon the market in Europe, I will stand by my statement that they have not been the success which has been desired.

Mr. King—I would like to understand the basis of the heat units in the calculations made by Mr. McMillin.

Mr. McMillin—I used the English unit, because I supposed most of our members were more familiar with it.

Mr. Lowe—I had no intention of speaking of the Los Angeles matter. In fact, I do not think anything that has been in operation only a short time, like our method there or that of the Loomis people in Philadelphia, is worthy of discussion here, because these things are foreign to our subject. I want to ask Mr. McMillin as to the cost of gas in the holder, based on coal at $5 per ton. I have been unable to follow the tables given.

Mr. McMillin—The tables show the cost, practically, to be 10 cents with coal at $3. If you add one cent for each 50 cents increase in the cost of coal per ton, you can make the calculation.

Mr. Lowe—That would make the cost of your gas 14 cents in the holder, as I understand you. This gas has a calorific value, then, of about what ordinary crude water gas has?

Mr. McMillin—Yes.

Mr. Lowe—Quite flattering to the water gas, at any rate. Then your gas consists of about one-fourth nitrogen. I think you stated it at 26 per cent.

Mr. McMillin—Yes.

Mr. Lowe—As matter of fact, then, your gas is considerably poorer than water gas, and lower in calorific value, inasmuch as you must heat up that nitrogen at the cost of combustion of your gas before you have the value of your combustion of gas.

Mr. McMillin—You speak of calorific value; I supposed you referred to the theoretic value. The available value is a matter that I called attention to in my paper.

Mr. Lowe—That would be greater where your gases escape at a high temperature and it would be smaller where they escape at a low temperature.

Mr. McMillin—Yes.

Mr. Lowe—But, as matter of fact, you use more nitrogen to heat up that gas.

Mr. McMillin—Yes.

Mr. Lowe—Then your gas would not be as good as water gas. How could you——

Mr. McMillin—Make your speech, and then I will make mine.

Mr. Lowe—You gave us 40,000 feet of gas per ton of coal as the fair output of water gas. Have you ever made fuel water gas?

Mr. McMillin—Not very extensively.

Mr. Lowe—In Lynn, on the very small daily quantity of gas now being made there, we get 60,000 feet of gas out of 2,240 pounds of coal. I am sure I can get as high as 80,000 feet from one ton of coal on a production of 500,000 feet of gas per day. Of course the cost of the gas depends to a great extent on the amount made. I do not know that your paper stated anything about the amounts of gas made in proportion to the cost of the gas; but that has a great deal to do with the matter. I think, in the case of water gas, it has considerable more to do with it than in the case of the gas you mentioned, because we can, by increasing the size of our apparatus, get considerably more gas from it for the same labor than you can by increasing your retort system, inasmuch as when you increase your retort system you increase your labor account, which we do not do at all. I do not think, on the whole, that the gas is as good in any respect as uncarburetted water gas. You could not use your gas in a gas engine, as made to-day, nearly so well as we can, for the reason that one-quarter of the gas in the cylinder of the engine would be an incombustible mass. Therefore, I doubt whether your gas would have much value for driving a gas engine.

Mr. McMillin—But it is driving more engines now than water gas is.

Mr. Lowe—We are only driving five in Lynn, but we are doing so quite satisfactorily. I think this gas you speak of is made by the process advocated by the Westinghouse people, of Pittsburgh; is it not?

Mr. McMillin—Not that I am aware of.

Mr. Lowe—I think I saw something of that kind stated in a paper

which you had read before a geological society in Ohio, mentioned recently in a Philadelphia paper.

Mr. McMillin—That had a different composition.

Mr. Lowe—So far as I can judge, I do not see you have shown us that your gas, taking water gas as a standard, is as good as our crude water gas; that you have shown that it costs more than I can put gas into the holder for; and that you have not allowed a fair amount of gas per ton of coal. I do not know but what that would be in your favor in your case, because we can make more than you could.

Mr. McMillin—I am glad you noticed that.

Mr. Lowe—I think the point that I called your attention to before is one generally overlooked by gas men when they speak of the difference of thermal units in the gas. They do not take into consideration the amount of heat which they carry away from the gas when they mix it with air. As matter of fact, I have taken a quart of water and boiled it with less water gas than I could with coal gas diluted with air. By differing the amounts, I have reversed that. In fact, I do not know but I can show, in favor of almost any system, very satisfactory results in theory. I do not think you have shown that your gas is any better than the crude water gas. I am a strong adherent of crude water gas. I would like to have you show us just where the gases are of equal theoretical value, as far as heat is concerned, and where your gas is as good as water gas.

The President—If anyone else desires to question Mr. McMillin I hope he will do so promptly. We are pressed for time, and must soon draw this discussion to a close.

Mr. Loomis—I am very much pleased with Mr. McMillin's paper. I think he has given us a very fair account, and that the paper is well worthy our consideration. With regard to this mixture of gases, I may say I have an apparatus at work at Turner's Falls, Mass., and hope in a few days to be able to give the results. I am arranging to have these gases mixed, or so that we can use pure water gas, and any quantity of coal gas, having them mixed in one holder or the other. Meters will be supplied, and the gas will be put on to the forges to be used in crucible steel melting, iron melting, and all that class of work. I will make this gas, as well as pure water gas, in the same generator, and carry it into the different holders, in the same operation—only at different times; and then I will invite this Investigating Committee which you propose to appoint to come there and investigate it, and they will be able to report just what can be done. We shall have an analysis of the gas made in each case.

The President—I think that will be beyond the scope of that Committee.

Mr. Loomis—Or any other Committee you may appoint. Any who wish to come there will be able to see what is done.

Mr. A. C. Wood—I have listened with a great deal of pleasure to the paper read by Mr. McMillin, and if I understand the case aright his presentation of it is altogether theoretical or speculative. I am quite surprised at the results he arrived at in the volumes of gases required for the work, for we have the testimony of our own members here, who tell us their actual experience of the volume of natural gas required to do the work of a ton of coal. If I remember rightly it varies, in different localities, from 22,000 to 30,000 feet to do the work of a ton of coal of 2,000 pounds. Further than that, we have the written testimony of the projector of a water gas system, claimed to be far superior to all others, that from actual test (nothing speculative about this), and from his own knowledge, 1,000 feet of fuel water gas is equal in value to 40 pounds of coal, or 50,000 feet to 2,000 pounds of coal, consequently I am quite surprised at the volume that Mr. McMillin arrives at in producing equal value to a ton of coal.

Mr. McMillin—Out of 16,000, do you mean?

Mr. A. C. Wood—Yes.

Mr. Lowe—I would like to ask another question. Will you kindly tell me the ignition temperature of this mixture which you speak of?

Mr. McMillin—I do not believe I figured that out. I should judge it was about 4,000. I will say, in figuring these values of the gases, I was aware that, in water evaporation of a 1,000 pounds of each, the extra nitrogen, or the extra quantity of air that may be in any of them, is taken into consideration—that is, of all the gases escaping at 500°. First, we have to compare the specific heats of the gases, working upon that basis. That is already accounted for in any statement I have made. I do not think I worked out the flame temperature of the gas, but judged it to be about 4,000—quite high enough. The producer gas makes a temperature quite high enough for all metallurgical purposes. Mr. Wood speaks of 20,000 or 25,000 feet of natural gas being equal to a ton of coal. That is a theoretical value and not a practical one. Just so it is with your water gas men. I cannot help what men may have said; I speak of what the fact is. In respect to water gas he is giving the theoretical value. I give the theoretical value of this as requiring 80,000 feet to a ton of coal; yet I say 16,000 feet would, in practice, be equal to a ton of coal. As to the nitrogen in the mixture, I would prefer to have that mixture without the nitrogen. Not being an expert in the manufacture of that gas, of course, I could not get it done as cheaply as Mr. Lowe makes water gas at Lynn. In figuring the cost of water gas I did not take my own ideas about it at all; I took those of large water gas producers, such as the firms in Chicago, Philadelphia, and other places—and, among others, Prof. Lowe. I have taken all the testimony that I could get as to the cost of the gas. I do say we ought to get better results; but I question whether it is a physical possibility to get 80,000 feet of gas and generate your steam and decompose it. I question very seriously whether there is heat enough there to get 80,000 feet of water gas per ton of coal.

Mr. Lowe—Theoretically you can get 120,000 feet of water gas.

Mr. McMillin—I beg your pardon; you cannot do it theoretically.

Mr. Lowe—You can, providing the coal is pure carbon.

Mr. Clark—Recognizing the importance and value of Mr. McMillin's paper, I move a hearty vote of thanks be extended to him, and that printed copies of his paper be distributed among the members at as early a day as possible. [Seconded by Mr. Lowe.]

Mr. McMillin—I have always opposed the distribution of printed copies of papers, and I must oppose this motion now. When I was President of the Ohio Association I broke through the rule with respect to having the President's address printed. This will all come out in due time through the regular journals, so do not let us make any exception in respect to the printing of papers, or distributing them, unless the party does it himself before the meeting. You will get the paper in a few weeks anyhow, and it will keep.

The President—I think Mr. McMillin's suggestion is a good one. [Mr. Clark's motion prevailed.]

### Report of Special Committee on a Uniform Standard of Meter Connections.

Mr. Goodwin—If it is the pleasure of the Association the Special Committee appointed yesterday morning to consider the subject of a uniform standard of meter connections beg leave to make a report. I will say also that the meter manufacturers named on the Committee were all present, with the exception of Mr. Tufts, who was not able to arrange for leaving his city at such short notice. This is their verdict:

The Committee to whom was referred the question of uniformity of meter coupling beg leave to submit the following report: That it is the sense of the meter manufacturers that there should be a uniformity of standard of coupling, but the subject is of such importance that the time at their command will not admit of its proper consideration at this date. They therefore ask that they be continued until the next annual meeting, at which time they will be prepared to report.

In the mean time your Committee ask that the Association express its opinion on the desirability of adopting a uniform standard. Your Committee further request, if it is the sense of the Association to adopt a standard, that the Secretary of the Association be instructed to forward a certified copy of such action to the New England, Western and Ohio Associations, and solicit similar action on their part.

Mr. Harbison—I move the report of the Committee be accepted, and that the matter be recommitted to them, to report definitely at the next annual meeting. Also, that it is the sense of this Association that a standard coupling is desirable. [Adopted.]

Mr. E. J. King, of Jacksonville, Ills., read a paper on—

### THE ADVANTAGES OF GAS COMPANIES ENGAGING IN THE ELECTRIC LIGHT BUSINESS.

That the electric light must either be looked upon as a rival interest and an active competitor, or a part of the gas undertakings of this country can no longer be doubted. I take it that your Committee, in assigning me this subject, had in mind the discussion of the question whether or not the advantages that gas companies may have over all others are such as to warrant them in the necessary outlay for the installation of a plant, with not only the possibility but probability of competition.

From the number of companies "joining the ranks" I think it has been decided that it may be considered a legitimate part of our business. That, with a properly constructed plant conducted on business principles, it can be made a profitable investment, I no longer doubt.

In a reported interview the manager of a large electric lighting system is quoted as saying he did not advocate the policy of selling to gas companies, as they would not endeavor to push the light as others would who depended solely on this light for their business. It seems to me he could not have looked very far ahead; for when gas companies shall have

taken hold and made it a part of their business, he who has courted their trade will certainly come out in the lead.

I do not believe that electricity is to drive gas for illumination out of the field, and that we can be comforted by knowing that our existing plant is to be devoted exclusively to "sending out" fuel. I do believe there is a place for electricity, that we as gas men are the proper ones to supply it, and that the time is coming when it will be so considered by all.

There was a good deal of philosophy in the reply of a certain gas man who, when asked if it were true that his company was going to enter the electrical field, replied, "Yes; and I should not be surprised if we were selling coal oil before long. We are in the light business."

So far the competition of electric light has not seemed to diminish the use of gas to any extent; in fact most gas companies report not only the average but even a larger increase than usual in their "sendout." But if the use of electricity continues to increase as it has in the last few years, will this always be true?

In our section of the country the arc light has almost superseded gas for street illumination. All buildings in course of construction, of any size or importance, in the various cities of the country are being wired for incandescent lighting. The report comes that all manufacturing establishments supplying electric lighting material are far behind their orders. Does all this mean that after 6 or 7 years' use it has been found unprofitable to engage in electric lighting? or that the demand is growing less?

Undoubtedly there have been failures and unprofitable investments in this field; but has failure been the rule? I certainly have not heard of a gas company that tried the experiment and failed. Now, let us see what advantages the average gas company may have.

*First.*—I would say, in saving on cost of installation, the probability is that all companies can find the small piece of ground necessary on the property they own, and, maybe, sufficient room in present buildings—by rearranging and economizing in space. For necessary foundations, a grout made of old retorts, firebricks and refuse of various kinds, broken to the proper size, can be utilized with spent lime—which is almost as good as cement for this purpose.

*Second.*—The saving in expense of management cannot be questioned, That, with the force necessarily a part of the gas plant, fewer men will be needed must be apparent.

*Third.*—Gas companies have a certain amount of refuse that otherwise would be waste, which can be used for fuel. For instance, coal dust, coke breeze, and more or less coke that can be secured by screening their cinders. All these we use on ordinary grate bars, with the help of a Parson's blower. If a furnace adapted more especially for this kind of fuel, say, something on the plan of our regenerative or recuperative furnaces, made to supply a battery of boilers, were used, the expense might be reduced to a minimum. Many are using the "Jarvis setting" to good advantage. Burners for using oil and tar are also being perfected. Possibly, when prices for tar are such as have obtained during the last few years in many parts of the country, it might be found profitable to make light of it.

*Lastly.*—Fuel gas. Who can realize the possibilities and advantages that gas companies may have over all competitors when they shall be able to use for fuel, or directly in the engine, a gas that costs them but from two to three cents per 1,000 cubic feet? This, you know, we are promised.

In several discussions in our Western Association it has been argued that interest on the proportion of value absorbed from the existing gas plant in construction, and its proportion of the expense of managing, etc., should properly be charged up to electric light, which would decrease the reported per cent. of profit. Grant this be true; but would you not then have another advantage to gas companies, in that their expenses would be decreased just so much—the result to the stockholder, however, being just the same in dollars and cents?

Now, may it not also be an advantage to the consumer? It has been the history of gas companies that they have endeavored to furnish gas at as low a price as possible, in justice to themselves—the "dollar mark" being the dream. May we not expect them to carry the same policy into any new departures? I know this to be the feeling of the Directors of the Company I have the honor to serve. Taking hold of the electric light when a local company made a failure of it, they have reduced the price from $12 and $15, for an 11-o'clock circuit, to from $6.25 to $8 for a 12-o'clock circuit. What company in the country, without competition, is supplying arc lighting at the price noted? What company can do so, and pay satisfactory dividends, with only a 63-light plant, unless it be a gas company? Is it not true, also, that men educated to the business of furnishing light will understand the necessities and wants of their patrons better than men who have suddenly entered a new field?

The tendency of the day is to trusts and combinations generally, with the understanding that a great saving may be expected. How truly this may be applied to the question we have now under consideration. I have corresponded with and talked to quite a number of the members of gas companies who have made such a combination, and in no case have I heard them complain they made a mistake. There are, no doubt, many other advantages that might be claimed which have not occurred to me; but I believe those I have enumerated are sufficient to make an electric light plant a profitable investment to gas companies, when to others not so favored it would prove an absolute loss—at least this is true in small and medium-sized cities.

*Discussion.*

Mr. Pearson—I belong to a Company (Toronto, Can.) which has not yet seen its way clear to adopt the electric light. My opinon is that it depends a great deal upon the ability of the company to sell cheap gas as to whether or not it would be advisable to adopt the electric light. So far as Toronto is concerned we have been enabled successfully to compete with the electric light. The fact of the matter is that the use of the electric light in our city has not advanced at all since they commenced it some 3 years ago, excepting as to the number of lights which the city leases. As a matter of fact I think I am within truth in stating that scores of people that tried the arc electric light after a time gave it up, because the expense was greater than that of gas, and also because of its inconvenience. The introduction by our Company of gas lamps of high illuminating power has enabled us not only to successfully compete with the electric light for inside illumination, but also to have these lanterns substituted for electric lights on the outside of buildings. The lamps that I refer to (of course, there are many others probably equally good) are what are called the "Lambeth Lanterns," made in England. These consume about 25 feet of gas per hour, and supposing they are lighted, say, for 5 hours (which is really as long a time as they are required to be lighted for advertising purposes), then the amount of gas consumed would be only 125 feet, which, at our lowest gas rate, would only amount for the whole night to about 13 or 14 cents, as against from 30 to 50 cents charged by the electric light company for their lights. Therefore, you see that with this lantern—which is quite as effective for their purposes, and sometimes more so than the electric light, for a little more than one-fourth of the price—they have an excellent service. The Gas Company's business in Toronto has increased, as we reduced the price of gas, very largely, far more than the increase in population of the city, which also is large. The electric light, as I have just said, has not increased. We have in our city, with a population of over 140,000 people, but 66 private arc lights, and, I think, 100 public lights, while we have 9,065 gas consumers, and 3,020 ordinary gas lamps. We have introduced for the city 63 of these Lambeth lanterns, and we supply 83 of them to private consumers. The price charged (of course, this is an important factor) by the electric light company to the city was 55 cents, but it has been recently reduced to 50 cents per night. The price charged for the gas lanterns and for ordinary gas lamps—the Company putting in the pipes, attending to the lamps, and doing everything connected with them—is, for a burner 3½ feet per hour, $20.50. The price for gas charged by the Company to ordinary consumers is now $1.25; to consumers of over 200,000 feet, $1.15; over 500,000 feet, $1; to gas stoves and engines, $1. The actual increase in the business of the Company during the past year has been nearly 17 per cent., whereas the actual increase in the population has been about 8 per cent. I do not say that it may not be well for gas companies in some places to use the electric light, but I cannot see that it would be well for us in Toronto. Why should we, even if we could supply electric light cheaper than other people, thus bring it into the market? Why should we do that, and make a smaller profit out of that light than we make out of our gas, and thereby hurt our business by so doing? Again, what guarantee have we, should we adopt any one system, that somebody else would not come in to oppose us, and, perhaps, do so without a profit to themselves for a considerable time.

The President—I think the Association would like to hear from some gentlemen who are doing this thing. Perhaps Mr. Stiness will be willing to say something upon the subject.

Mr. Stiness—I suppose that for many years I have been regarded as somewhat of a crank for favoring the adoption of the electric light by the gas companies of this country. That a very large number of them have now come into line is a matter of satisfaction to me. As our friend from Toronto says, perhaps individual cases exist where it may be not for the best interests, financially, of the gas company to adopt the electric light system; but, sir, as sure as the sun shines to-day, the electric light has come to stay, and to exist as an active competitor of gas. I am not one of those who believe or maintain that the gas works of the United States are to be annihilated, or are to be entirely turned into

mediums for furnishing heating gas. The electric light has its field and will maintain it, and so has the illuminating gas of the present day. The policy of furnishing electric light to their consumers when they demanded it has been pursued by many gas companies throughout the United States. I have always maintained that the term "gas company" was, and is at the present time especially, a misnomer. We should be called "artificial light companies;" and even if our consumers demanded from us a supply of oil, I do not know why we should not do so, if the operation was a profitable one. Apart from other considerations, I believe there are so many advantages in the use of electricity at the present day that the people will have it. I have no knowledge of any lamp, at the present time, that can be used successfully in the lighting of streets, that can be compared with the arc light of to-day, although I believe there are many gas lamps which will more than successfully compete and compare with the incandescent. When we pass through the streets and see, as we can in almost any city in our country to-day, the arc illumination that is being carried on, I contend that it is a benefit to mankind. The statement was once made, and I repeated it in our New England Association, that the Mayor of the city of Providence once said, "A city well lighted is more than half policed." I believe that statement; I know that it is strictly true. A few years, ago, in your own good city, Mr. President, where (accidentally) I was thrown into the company of the Chief of Police, he stated to me, in speaking of this matter of electric lighting, that it was of vast benefit to the city of Boston; and that while he complimented—a compliment which I know was well deserved—the Company with which our worthy President is connected upon the pure quality of the light furnished by the Boston Company, yet he said that the public demanded the arc light for the purpose of lighting the crooked streets of that well-conducted city of Boston. I believe no gas company exists that cannot make use of the electric light, and successfully carry it forward. There is one matter which has been suggested to my mind in regard to gas companies. Undoubtedly many of you, gentlemen, have seen in the papers the account of a gas and electric light company in the little town of Spencer, Mass. Two weeks ago to-night I visited that town; and, gentlemen, I say to you it will well pay you to also visit it. Situated upon the hills, in the center of the State, it is one of the most beautiful places I ever visited, and I was well repaid for the hours I spent there. There they have three 15-horse power Otto gas engines driving 63 arc lights. I remained in the dynamo room for 25 minutes, and there was never a "wink" of an arc light. I started last night—or this morning, perhaps I had better say—from the Hoffman House, marching up Broadway, and there beheld those waves of light which Prof. Morton spoke to us about yesterday. They were more than waves; they were pronounced undulations. But that was not the fact with regard to the effect of the gas engines in the dynamo room in the town of Spencer. I must say I was more than surprised at the regularity and efficiency of these engines to run the dynamos. They claimed, I think, that there was economy in the use of gas at $2 per thousand. In my investigation I did not take any man's statement, except in one particular—with regard to the consumption of gas per hour for running the dynamos I did take the statement of the gentleman in charge; but there were three large 50-light dry meters, one attached to each engine, and the three engines were directly connected with one line of shafting, and over that shafting was a belt to the dynamo. The consumption of gas would equal about 1,000 cubic feet per hour for the three engines. At a meeting of our New England Association a short time since, one of our engineers questioned the accuracy of the statement as to the consumption of gas. I believe that is pretty nearly what they claimed is the consumption of gas by a 15-horse power engine. I did not verify the statement by an inspection of the meter, because what I did see was so fully verified by what I had seen in the papers that I accepted their statement. My own experience, covering a period of three years, in running Otto engines of similar horse power, driving an exhauster to exhaust gas five miles from my works, has convinced me that their statement with regard to the consumption of gas was absolutely within the line. Now, if a 15-horse power gas engine can be run on 300 cubic feet (and it runs through my head that I have heard about gas being made at 5 cents per thousand), the possibility of the electric light lies in the possibility of gas companies to furnish the electric light at a very much reduced cost. The large number of electric light men who are getting into line, reminds me of the story of the Irishman at the democratic meeting. When the floor gave way, and they all went into the cellar excepting himself, he being left on the threshold, said, "By the Holy Moses, I will jump myself!" I am inclined to think that our good friend from Toronto, while still standing on the threshold, will yet go with the crowd.

The President—I think the Association would like to hear from Mr. Nettleton on this subject, as he has also had some practical experience.

Mr. Nettleton—While Mr. Stiness was making his speech it occurred to me that the flickering of the light on Broadway was not due so much to the flickering *per se* as to the flickering in his eye. The Company with which I am connected went into the electric light business in November, 1885. We were one of the first, if not the first, companies in New England to take hold of it; and I said then, as I say now, if we had not made any money, but had merely covered expenses, I would still be glad that we entered the field. It seemed to me, in a town as small as ours, where the field for lighting was so narrow, that two companies could not live and do business. It ought to be done by one company. Since that time a town in Connecticut selling one-third the quantity of gas that we do, has had a competing electric company. The men who owned the electric light plant have pushed the business so strong that the Gas Company has felt very much like going out of business. That may be an exceptional case; but although they have never sold more than one-third the gas sold by our Company, they have a good many more electric lights than we have. It simply shows the difference between an electric light plant in a small place, operated by the gas company, pushed by consumers (because it is a competitive company) and pushed by people who feel that their existence depends upon pushing the business to the utmost possible limits, and an electric light plant operated by a gas company who simply run it to supply the demand which everywhere exists for electric lights. Now, as to the results. We run by water power, and for that power we have as yet paid only $1,000 per year. The actual running expenses have been charged up to the account, also the small repairs which have been made so far, and nothing else. In starting, through the month of September, we had only 3 lamps, but shortly afterwards (in January) we secured a small street lamp contract. Up to the 1st of April following we had 33 or 34 lights; and we had lost, up to that time, $275. For the following year, ending April, 1887, we ran from 33 lamps up to 64. We had at that time an investment of $15,000, all told; and we had made on that investment only $500—which is not very much. For the year ending April 1st, 1887, we only did a business of $3,300. We have gained now so that we have to-day the equivalent, turning incandescent into arc lamps, of 90 arc lamps. We are doing business at the rate of over $6,000 per year. The account at the present time stands on our side by considerably more than the whole of last year. Unless we meet with some accident or something which causes a large expenditure, we shall make on an investment which now stands at about $20,000 not less than $2,000; and it may run higher. The profits would increase proportionately as the business expanded, and be considerably larger than they are now. It is very much like the gas business. If you do but a small trade your income is eaten up by the expenses; if you do a somewhat larger business you make a little money; if you do a still larger business, then you make considerable money. That is very true of the electric light business. I shall not feel satisfied—shall not feel that the Company is whole, is being paid directly in money, until we shall have made 16 per cent. upon the capital actually invested. I do not think we have earned it at the present time. That 16 per cent. I would divide as follows: 6 per cent. for interest; 8 per cent. for depreciation; 2 per cent. for office expenses. When we reach that point I think I can safely say the Company is whole. But indirectly I feel that it has been one of the best investments the Company has ever made.

Mr. Helme—How much do you get for gas?

Mr. Nettleton—Last year $1.71 was the average.

Mr. Neal—I will not enter into details as there is not time; but I will state that the Charlestown Gas Company which I represent entered into the supply of electric lighting on the 15th of September, 1886, and the business has been carried on, financially and practically, with great success. We furnish the arc light and also the incandescent. The incandescent is not the Edison, nor the alternating current, but the "individual cut-offs," as it is called. Each lamp has a regulator by itself. We have but one price for each arc light for commercial lighting, and one price for 8 incandescent lights for commercial lighting. We have a contract with the city for three years at a different price. We have no reason to regret having taken this step. I cannot give the figures that I would like to give, but the results are very satisfactory, I only wish a way was devised by which water gas, coal gas, and the electric current could be so combined as to send the whole through one burner to the customer.

Mr. Lansden—I would like to ask Mr. Nettleton whether or not the introduction, and what he has done with his electric light, has had any effect upon gas consumption? Whether his gas consumption has increased or decreased; and what amount in his profits he has charged up

to the superintendence of the works? Also, whether he has put it all on the gas company, or divided up the expense with the electric light company.

Mr. Nettleton—In answer, I will say that the consumption of gas is increasing slowly—not so rapidly as it did four or five years ago; but I think this is due largely to the fact that the town is not growing so rapidly as it did then. As I stated in my remarks, the expenses given were about the actual operating expenses. Nothing is charged off for my salary, or for office expenses; and nothing is charged for superintendence or collections as yet.

Mr. Monks—I would like to ask Mr. Nettleton whether he can do a larger electric light business without further expenditure; and how far he can go in that direction?

Mr. Nettleton—The plant consists of two 45-light and one 50-light dynamos, making a total of 140 lights.

Mr. Coggeshall—How many gas lights do these arc and incandescent lights displace?

Mr. Nettleton—I prefer to answer that question after dinner.

Mr. King—I desire to say a word or two in answer to Mr. Pearson. His experience with high-power burners has been entirely different from ours. I have put the electric light in stores and rooms which I tried to light by high-power burners, and the result has been eminently satisfactory to the parties using the electric light. The argument in favor of the electric light is this: When I used the high-power burners I had it on my mind all the time, if there was not a customer in the store, that I had the gas to attend to, and that I must shut up early and save gas, if there was no business. I had that on my mind all the time—the care of the burners. But since I have had the electric light I know that when I shut up and go home my store is illuminated brilliantly, my windows are nicely illuminated, and I have an advertisement there until 12 o'clock at night. I have to pay no attention to lighting or putting it out, and have no care whatever on my mind. The increase in the sales of gas has not only kept up with the average, but is about 2 per cent. more than the average. So far as the profits are concerned, we have reached what we hoped for, and 1 per cent. more, for the last year's business. As far as competition is concerned, I may say I care not who comes; for I claim that my advantages are such, as a gas man, that, with the advantages which I have enumerated in my paper, I certainly can compete and hold my own against anyone. As to depreciation, of course, with only something over two years' experience, we cannot judge what will be the proper charge to make; but I think that probably what Mr. Nettleton states (8 per cent.) would be fair. Our plant shows very little depreciation at this time, but of course we cannot tell what is in the future. It is high-speed machinery, and there must be more or less charged over to depreciation.

Mr. C. Nettleton—What price does Mr. King get for arc lights burning until 12 o'clock?

Mr. King—$8 where there is one light, and for the hotel; $6.25 for others.

Mr. Pearson—What is the price of gas?

Mr. King—Our price is from $1.50 to $2 per thousand, according to the amount of consumption.

Mr. Pearson—When you speak of $6.25, it is for how long?

Mr. King—Until 12 o'clock at night; $6.25 per month.

Mr. C. Nettleton—What price does Mr. Neal get, and how many hours does the light burn?

Mr. Neal—What we call commercial lights are now lighted at dark and turned off at 11 o'clock. We stop the current then. We charge 50 cents per night—that is, for the arc. If we give them 8 incandescent lights we charge 50 cents for those. We have in some cases put in incandescent lights in stores, or business places, where they never used any gas, but have always used kerosene oil; so that we are indirectly interfering with the Standard Oil Company.

Mr. Pearson—If the same energy had been put forth in introducing these high-power burners in opposition to the electric light as the electric light people put forth in introducing their burners in opposition to the gas companies, in many places the gas companies would succeed in defeating competition. I believe that, comparatively, a small cost and little effort would succeed in having them put in. Our experience, as I have stated, has been exactly the reverse of that of Mr. King.

The President—Mr. Pearson's situation is somewhat different from that of smaller companies. Most large companies can afford to wholly ignore the question of introducing arc lights, but the question of incandescent lighting is a very different matter.

Mr. Lowe—Does Mr. Neal use the incandescent on the arc light line?

Mr. Neal—I do.

Mr. Lowe—What system do you use?

Mr. Neal—The Brush.

On motion of Mr. Pearson, a vote of thanks was tendered to Mr. King for his paper.

### Committee on Badges.

The President—The Chair will appoint as the Committee on Badges, according to the resolution, C. H. Nettleton, G. B. Neal, and S. G. Stiness. The Chair appoints those three gentlemen from the same locality, in order that they may confer together. I think it would be more convenient than to have them scattered about the country.

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### Second Day—Afternoon Session.

### Committee of Arrangements for Toronto Meeting.

The President appointed as the Committee of Arrangements for the next meeting, at Toronto, Messrs. W. H. Pearson, of Toronto; J. S. Scriver, of Montreal; F. W. Gates, of Hamilton; G. A. Hyde, of Cleveland, Ohio, and Wm. Cartwright, of Rochester, N. Y.

Mr. C. W. Blodget, of Brooklyn, N. Y., here read his paper on—

## THE COMPARATIVE ILLUMINATING POWER OF GAS PURIFIED WITH LIME VS. OXIDE OF IRON.

Something over a year ago the Company with which I am connected commenced to use Connelly & Co.'s iron sponge for purification. Being fully impressed with the fact, as laid down in all the text books, that carbonic acid was highly detrimental to the illuminating power of gas, and knowing that oxide of iron had no affinity for $CO_2$, it was deemed essential to bring the gas in contact with lime in order that the $CO_2$ might be eliminated; otherwise the benefits it was expected we would derive from the use of sponge would be more than lost through the depreciation of the illuminating power of the gas due to its presence.

To avoid such a contingency a layer of lime, 4½ inches deep, was spread on trays resting on the lowest offset in the purifying boxes, with the object of not only extracting the $CO_2$ but, in addition, to serve the purpose of arresting any particles of tarry nature which occasionally come over with the gas from the scrubbers, and preventing same from permeating the sponge, which rested on trays placed immediately over the lime.

With this arrangement of materials matters ran smoothly for about a month, when we commenced to find carbonic acid in the gas long before it would be necessary to change the purifiers on account of the oxide being fouled, although the latter was purifying but little more per bushel than formerly.

In accordance with the precepts this condition of affairs was not allowable, and consequently we adopted the (to us) novel programme of endeavoring to change the purifiers whenever $CO_2$ was shown to be present in the gas, without waiting for the sponge to show indications of being fouled with sulphur compounds; but this plan proved a flat failure, for we would find carbonic acid in the gas within two hours after changing.

Finding it impossible, by means of the plan adopted, to get rid of the objectionable visitor, and being loath to abandon the use of sponge, it was determined to discard the lime entirely, to substitute sawdust for the purpose of arresting any substances deleterious to the sponge from passing to it, and to ascertain from personal experience what would be the effect upon the illuminating power of the gas of allowing the carbonic acid, still present after leaving the scrubbers, to remain. As soon as this change was inaugurated the candle power was most carefully noted, and to our astonishment the quality of the gas was found to be fully equal to that which it was our custom to make.

In order to corroborate the candle power of the gas as determined by the bar photometer, we caused to be made and placed in the photometer room two small purifying boxes (20 in. by 20 in.), through which gas from the outlet of the scrubbers was passed to the bar to be tested. In these boxes was placed, respectively, lime and iron sponge to the depth of 12 inches, each containing the same amount of moisture they ordinarily had in our practical operations. We were then (supposedly) in a position to make a comparison of the candle power of gas with and without carbonic acid.

One important factor, however, had been overlooked—viz., the constantly varying character of the gas being made; and as some little time necessarily elapsed between the readings, the obtainment of accurate results was impossible.

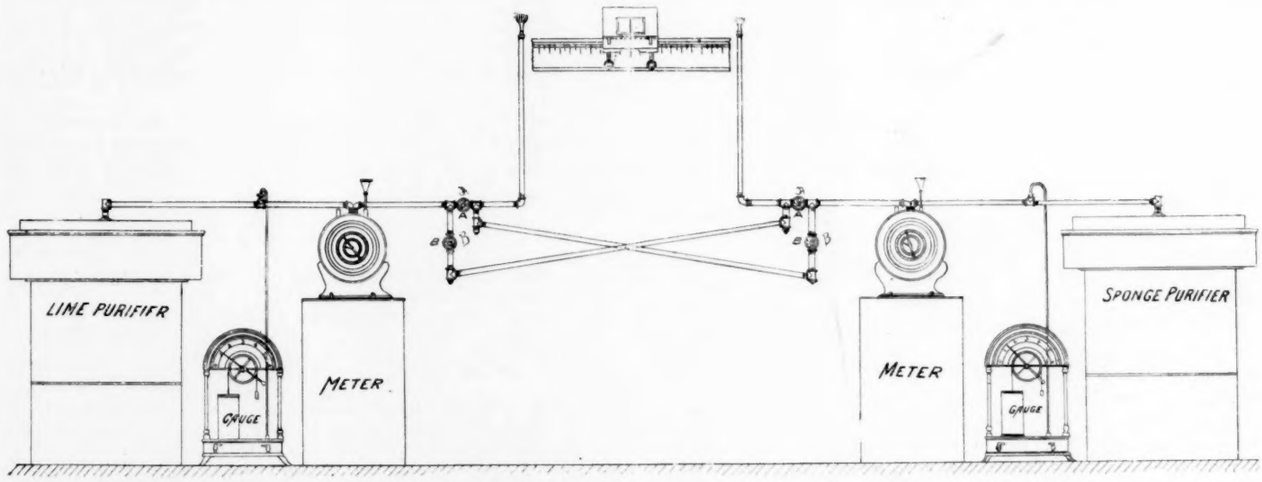
Two governor burners, which upon test were proven to consume equal quantities of gas under varying pressures, were then placed on either end of the bar, and the luminosity of the two flames compared—the piping having been previously so arranged that the gas from each purifier could be passed to either burner at will; but as, for some unaccountable reason, the height of the two flames constantly varied, no dependence

could be placed upon the observations. Further experiments were (owing to press of business) abandoned until last month, when the matter was again taken up.

A second experimental meter was procured, each purifier connected with one, a "Bray Special, No. 7" burner put on each end of the bar, and pressure gauges placed before the inlet of the meters.

The separately purified gas was passed to each meter at one inch pressure, when it was found that each burner consumed exactly six cubic feet per hour.

A comparison of the illumination of the two lights, one against the other, showed them to be equal; for although each gas was repeatedly switched from one end of the bar to the other the disk remained in the center. This would seem to verify beyond the shadow of a doubt that the illuminating power of gas purified with oxide of iron was as great as that purified with lime, and to fully substantiate




the correctness of the candle power of the commercial gas, as observed daily.

The average results obtained during eight months' practical operations, with lime as against iron sponge, are as follows:

| | Make, per pound. | Candle power. | Candle feet. | Per cent. of cannel used. | Candle feet for each per cent. of cannel used. |
|---|---|---|---|---|---|
| Lime gas ($CO_2$ not present) ... | 4.94 | 18.6 | 91.9 | 9.64 | 9.53 |
| Sponge gas ($CO_2$ present)..... | 4.9 | 19. | 93.1 | 9.64 | 9.65 |

Admittedly, carbonic acid is detrimental to the illuminating power of gas in which it is present. How, then, are we to account for the fact, demonstrated day after day for months, and verified by the experiment above mentioned, that gas (made in both instances from the same coals) containing an average of two per cent. $CO_2$ is equal to that from which this deleterient has been eliminated?

It was suggested to me that the cause for this apparent paradox might be found to be due to the fact that the lime robbed the gas of some of the hydrocarbons which the oxide of iron allowed to remain, and that the increased percentage of illuminants contained in gas purified with the latter material equalized the baneful effects of the $CO^2$.

To determine whether this was a fact I arranged to have thorough analyses made of the lime and sponge gas, so to speak, by the Bunsen method, the results of which are here given:

| | Lime. | Sponge. |
|---|---|---|
| Hydrogen | 48.92 | 47.33 |
| Carbonic oxide | 6.02 | 5.84 |
| Carbonic acid | .00 | 2.19 |
| Marsh gas | 36.86 | 36.05 |
| Illuminants | 5.65 | 6.14 |
| Oxygen | .12 | .09 |
| Nitrogen | 2.43 | 2.36 |
| Total | 100.00 | 100.00 |

It will be observed that while the sponge gas contains 2.19 per cent. of $CO_2$ it has also .49 per cent. more illuminants than was found in the gas purified with lime, which fully accounts, I believe, for the fact that the illuminating power of gas thus separately treated as to purification was found to be equal.

*Discussion.*

Mr. McMillin—It gives me much pleasure to listen to papers of this character, for two reasons; first, because of its eminently practical nature, and, secondly, from its substantiation of views advocated by me at some risk to my reputation as an engineer. For many years I have contended that gas purified by oxide of iron was as good as that purified with lime alone. I had supposed that gas purified with a little lime and a great deal of oxide of iron would be better. That point, however, I never determined. All the analyses I ever made demonstrated that there was a higher per cent. of illuminants in gas purified with oxide of iron alone. I have made no analyses recently, and cannot give results. While Mr. Blodget's paper only shows one-half of one per cent. of illuminants, it is nearly equal to an increase of 10 per cent., there being but little more than 5 per cent. of illuminants in the lime gas, and a little more than 6 in the other. Really it shows about 10 per cent. of increase of illuminants. Some years ago I made an experiment in retorting my lime—the lime had been used for some time—to determine whether there was anything absorbed by the lime that would make light. It was mixed with coke screenings, which would probably make a difference in the quantity of gas to be made—not because there was gas in the coke, but because from the moisture present in it we might get a little water gas. I made from lime taken from the bottom purifier, which had been in use ten days, 1.85 feet per pound of 13-candle gas. Necessarily some illuminants must have been taken from the gas before you could get any such result as that. I would not advise you to use it as regular provender for making gas; but, unquestionably, the lime does absorb a great deal of illuminants.

The President—Was there any tar in that lime?

Mr. McMillin—Not noticeably. I will say that, before the gas reached the lime, and in addition to the ordinary scrubbing it had received, it went through three feet of coke screenings, used in the old purifiers that were to be abandoned, but that were still in position; hence it would have been impossible for much tar to have accumulated. I would have supposed that the quantity came rather from the coke moisture. The illuminants came, of course, from the illuminants absorbed by the lime.

The President—We have another paper on a kindred subject to be read, and I think it would be better to read it at this time, and have the two papers discussed together.

No objection being offered, Mr. Thos. Turner, of Charleston, S. C., read his paper on

## PURIFICATION PUZZLES.

Mr. President and Gentlemen of the Association:—Our worthy Secretary, who is indefatigable in his pursuit of literary matter for our meetings, requested me to prepare a paper on "Purification with Iron Sponge," forgetting, I suppose, that I have been fully occupied in recovering and repairing damages from a bad attack of the "shakes." In consequence I feared I would not be able to do justice to the subject. However, I therefore submit the following on "Three Purification Puzzles," hence the title:

I do not know that there is anything unique about them, as some of you may have had similar experiences; but still I think they will promote discussion, and probably develop some information which may be of benefit to all of us.

A description of our condensing, scrubbing and purifying arrange-

ments is as follows: A Pelouze and Audouin condenser, 27 feet from take-off of the hydraulic main; 300 feet of 12-inch main, partly under floor of retort-house, an 8-inch air condenser, in 4 rows, 18 feet high, about 1,000 feet of 8-inch pipe; a scrubber 19 ins. by 5 ft. 6 ins., filled with wooden trays; a second scrubber, 15 ins. by 4 ft. 4 ins., filled with wooden laths set on edge; and 4 purifiers 12 ft. by 8 ft., by 2 ft. 6 ins., with dry center-valve and 12-inch connections. The purifying surface is, quite evidently, too limited for a manufacture of 200,000 or 300,000 cu. ft. per diem.

For years we worked with dry lime, in the usual manner, that is, 4 or 5 trays with lime about 2 1-2 inches in depth and mixed so as to ball in the hand without staining. As our manufacture increased we found the increase of pressure so great that, at times, it was sufficient to unseal the inlet to dry center-valve and blow out the water lute to boxes. In addition to this we were frequently compelled to change two and three purifiers per day. It had been recommended to our Board that we should increase the capacity of our purifiers; but before acting on the matter we received a welcome boon, in the shape of Mr. Theobald Forstall's paper* on "Lime Purification," read at our meeting in Washington, in May, 1875.

This mode of preparing lime was immediately put into effect, proceeding cautiously in the use of water. This did very well, purifying from five to six thousand cu. ft. per bushel of hydrate of lime, and even as high as 8,000 cu. ft., whereupon we were tempted to cry "Eureka"—when the process suddenly collapsed, and gave us Puzzle No. I.

Box after box was changed, but the gas seemed to run right through the lime without its scarcely taking effect; in fact we were purifying not more than 1,200 cu. ft. per bushel. The lime came out of purifiers almost unstained, and, after a few days' exposure to the atmosphere, seemed to regain its original purity. For a week we were compelled to change box after box—sometimes two, and even three in a day. There seemed to be no remedy for this state of things, but when we tried the experiment of putting in a drier charge of lime the evil ceased at once.

From this time we worked along very comfortably, purifying between six and seven thousand cu. ft. per bushel of hydrate of lime, when we were suddenly confronted with what I call Puzzle No. II.

At home one evening I took a match to light the gas, and, as sometimes happens, the match went out before the gas was ignited. The tap meanwhile being open my attention was attracted by the peculiar smell of the gas, and, on applying the nitrate of silver test, I discovered a considerable trace of SH. A hurried visit to the works and a test of the purifiers showed everything to be correct, but the gas coming from the station meter showed a strong trace of $H_2S$. The center-seal and connections were next examined, and all seemed to be in perfect order. On the next change of purifiers the trouble disappeared, only to return again in a few days; and so it continued, on and off, for weeks, much to my annoyance, during which time every conceivable thing was tried to find out the difficulty.

The disease after all was very simple, and the remedy applied was equally simple though effective. It appeared that the water used to seal the bottom of the center-seal had become super-saturated with SH, and as the clean gas passed out over the surface of this water it took SH in sufficient quantities to produce a very decided stain, when the usual test was applied. The remedy was a simple washing out of bottom of center-seal once or twice a week, and we had no further trouble. And here, let me say, I think it is a wise precaution to occasionally test the gas at the station meter.

In October, 1884, after various vicissitudes with dry lime, owing to the large manufacture on the limited surface for purification, we decided to try the experiment of using iron sponge with the hope of reducing the resistance in the purifiers. We were somewhat disappointed for several weeks, but eventually succeeded in working satisfactorily, or, with a manufacture of 280,000 cu. ft. per diem passing through our small boxes, and with about 3 inches back pressure, we were purifying 9,000 cu. ft. per bushel of sponge. From some unaccountable reason we afterward began to have trouble from sudden increases of pressure in purifiers, and from the rapid changes to reduce the pressure, our results fell off 50 per cent., and, eventually, 66 per cent. This was simply from increased pressure—the sponge not being fouled in the least; and yet we would make a complete round of changes in 24 hours.

From the prevailing state of things we got the impression that the material was in too finely a divided condition, and so absorbed moisture from the gas and clogged the screens, as it seemed to form into a pasty mass right at the screen. With this idea, earthenware pans, containing SHO, were placed in bottom of boxes to absorb moisture, and shavings, sawdust, gunny-bags and breeze were placed on an extra screen; but all to no good result. As a last resort a letter was sent on to the Messrs. Connelly—for of course (?) the fault could lie nowhere else than in the material—whereupon they suggested the addition of sawdust to the material. However, in the interval of receiving their reply, Puzzle No. III. had been solved. The remedy applied was simply by-passing the Pelouze and Audouin condenser for a few hours, and keeping the purifiers at a slightly higher temperature. It was the same old bugbear of the gas manager, viz., naphthaline, although it was not readily perceptible among the sponge.

Now, the query is, "Was this over-condensation?" Does the P. & A. condenser, under certain conditions, when removing the tar carry along with it too many of the light hydrocarbons, rendering the gas more liable to deposit naphthaline on any sudden change of temperature?

Notwithstanding an occasional drawback from the causes above mentioned, we are still using iron sponge; and, under these very disadvantageous circumstances, our present lot has purified about 122,000 M. cu. ft.

If the above will aid some brother gas manager in avoiding such annoyances—which, at the time of their occurrence, were serious matters to us—the purpose of this paper will have been fully answered.

The

*Joint Discussion*

was then proceeded with.

Mr. Graeff—I would like to ask Mr. Blodget what kind of photometer he used in making those tests?

Mr. Blodget—I stated that I used a bar photometer.

The Secretary—Experiments are sometimes funny things. I made just about the same series of experiments on the effect of carbonic acid that Mr. Blodget did. I took a small purifier in the photometer room, and, taking gas which had merely passed through iron at the works, I first tested it directly at the bar, and then passed it through the small lime purifier. I made a long series of experiments, but I can very quickly summarize them. The gas was analyzed, and as it came into the office (the tests were made at our office a couple of miles from the works), it contained 1.32 per cent. of carbonic acid, but when passed through the lime purifier it showed no carbonic acid. The loss of light in not passing the gas through the lime purifier, through a long series of experiments, was .8 of candle power on the argand burner, and 1.03 of candle power for the flat flame burner. Those results are just the opposite of Mr. Blodget's.

Mr. Boardman—I wish to ask Mr. Humphreys if the gas which, after passing through lime, gave him better results, had not also passed through iron sponge?

Mr. Humphreys—Yes.

Mr. Boardman—Therefore, I think it does not touch the point under discussion now. I understood Mr. Blodget to say that he tried lime alone, and sponge alone. He does not say in his paper, and I do not think he would say, after he had purified with sponge, and had passed the gas through a layer of lime, but what the gas would show higher candle power than it did after going through the sponge alone. As I understood his paper, he means that the sponge alone, or the lime used alone, gave him the same results.

Mr. Blodget—Exactly.

Mr. Boardman—I do not think there can be much doubt as to the benefit of passing the gas through a thin layer of lime after it has passed through the sponge, to take out its carbonic acid, but not to take out the illuminants.

Mr. McMillin—I have had similar experience to two of the "puzzles" of Mr. Turner,—that of foul gas getting into the holder, although pure in the purifying house. We have had it so on several occasions. I heard of his success in cleaning out his center-seal, still, I could hardly believe that that was the difficulty, without any increase of temperature, or that the sulphuretted hydrogen would pass off in such a quantity as to make the gas foul; yet I naturally tried it, knowing that it had succeeded with him. I derived no benefit from it. I could never get the same results. After some time, I discovered that one chamber of the center-seal would occasionally leak, and it would continue to leak. When I changed off from it the trouble ceased, but when I next got round to it the same difficulty would appear. We would be obliged, while on that section, to run the gas into the holder by itself, and let that be used in the day-time for cooking, or for leaking in the streets, and turn the other on at night during the burning hours. Of course we ground our center-seal all we could. After a while it stopped. We have been troubled for two or three weeks at a time, once or twice a year, for two or more years. With "Puzzle No. 3" we had difficulties last winter. From October, 1885, to March, 1886, we never changed the purifier because the oxide was foul, but always on account of the pressure. I am almost afraid to tell you that I have measured the naphthaline on the top of the outlet pipe of the box, five and a half inches deep; and, for weeks at a time, when I would

*See JOURNAL, June 16, 1875, p. 223.

lift the lid, the entire surface of the oxide would be covered so that you could not see any of it. It was not surprising we had back pressure with that much naphthaline. It was better, however, to have it through the works than to have it in the services about the city. We were having no trouble there. But, in March, 1886, I put in a lower layer, a tray of all coke, then another tray of half coke and half oxide of iron, and then a couple of feet of pure oxide of iron on top of that, but received no relief. I have recommended that medicine to all my friends who have been afflicted, and am prepared to take it myself. Two months ago, after we had been running along for some time, changing the box once a week or ten days, our pressure suddenly began to run up. We naturally concluded that it was the old trouble, but when we changed the boxes we saw no sign of naphthaline on top of them—not a particle. We examined all the boxes, took out the coke, put in fresh material, fixed everything in good shape, and ran 24 hours, and then changed again. Then we mixed in new sawdust. We had been running on that oxide for some time. We made the oxide nearly one-half sawdust, but without helping it one iota. It was a box which we changed every day, because of the pressure. We had continued that up to the time I left home. I left home with some misgivings. We started in just before I left home, to put on three inches of coke screenings in the second tray, and oxide on top of that. I have had two or three telegrams from home since my arrival here, and the pressure has not increased any. The surprising thing was that no naphthaline passed out; although the pressure would go from three-fourths of an inch on each of the second and third boxes, and an inch or an inch and a half on the first, up to 10, 12, or 14 inches, sometimes in an hour. Very seldom it happened that more than three hours from the time the pressure began to show an abnormal condition of affairs, we did not have to change. There was no naphthaline in sight, yet we were satisfied that naphthaline was what was the matter. My friend, Turner, remedied his difficulty by cutting out the P. & A. condenser. I have sufficient condensing and scrubbing capacity; and we cooled our gases down as low as 58° and 60° during the cool weather that we had, and we ran it as high as 125. We by-passed the half of our scrubber in the condensation; then we by-passed all of it, and ran the gases into the boxes hot, without being either washed or scrubbed. I ran steam, at a pressure of 60 pounds, through a 3-4 inch pipe, for four hours, when the pipe became so hot that you could not bear your hand upon it, but not an iota of relief was granted.

The President—I think a French philosopher has said there was something in the misfortunes of our friends that always caused us pleasure. I think if we once begin to take the experience of the members of this Association we shall have business enough to occupy us for the whole of our session, without doing anything else. I think Mr. McMillin, when he sat down, meant to move a vote of thanks to both of these gentlemen; and I take great pleasure in putting the motion. [Adopted.]

Mr. Richard J. Monks, of Boston, Mass., read a paper entitled,

## DISADVANTAGES OCCASIONED BY FLUCTUATIONS OF CANDLE POWER IN GAS FURNISHED TO CONSUMERS.

The practical and scientific advance made in the manufacture of illuminating gas since its first introduction, has resulted in a double advantage to the consumer—while he pays a less price he gets a much better light. That the light averages much better than of old is easily demonstrated; and while the average of your candle power is an important point, the uniformity is an essential one.

It is certainly true that so delicate and sensitive an organ as the eye acquires a strong habit in favor of uniformity in the volume of artificial light. Now, if your eyes find the volume of light uniform, the satisfaction this affords you reduces your disposition to complain of the light furnished.

In glancing over the history of our industry, the standard of illuminating power adopted a quarter of a century ago seems absurdly low; and this fact illustrates how comparison so often becomes the basis of our judgment, and how necessary it is that unfavorable comparisons as to the article we furnish should not prevail among our consumers.

Step by step we have advanced from being content to produce a twelve or fourteen candle gas, and while we have been educating ourselves to produce a superior light we have been educating the community to call for and require it. The older members of this Association can recall how, step by step, this process went on. Your modern consumer knows nothing about all this, and he cares less, but argues thus:—Your gas is poor to-day, because it is not so good as it was yesterday.

Suppose you assert that to-morrow you will please him, and, if your gas was "off" two candles, you put it up four. You are then like the milkman giving an unusual amount of cream to his customer; you must keep right on, for the moment you return to your normal standard you are denounced; and, should you happen to again get below it, you add to the general dissatisfaction.

It may be argued that such fluctuations as this are extreme, and unusual; and certainly the truer this argument is in any case the better for the company, although it may be said that occasionally men are put in charge of gas works whose frequent experiments amount to a tinkering with the quality of gas sent out.

Gas carefully made by any of the leading processes, when consumed, will produce a light which, for uniformity in candle power, will take front rank and can be kept within a very close range.

It will not be so brilliant as an electric arc, but it will not indulge in those light-giving gymnastics, which are sometimes observed in arc lighting. It will also surpass the incandescent light, not in steadiness of flame, but in uniform intensity.

This is a strong hold we still have over our modern competitor—electricity; and we ought to work it for all it is worth.

In the matter of how much light can be got out of a given quantity of gas, due allowance being made for the material and the process used, many gas men are now agreed, and endeavor to live up to the modern standard and keep close to it at all times.

Let us briefly consider some of the causes which tend to interfere with this.

Defective construction in some part or parts of our machinery; lack of vigilance in frequent examinations of the photometer; dead ends on mains where little gas is used; experiments carelessly carried on; and the mingling of different gases at irregular times and in irregular quantities. During the year, since we last met, a case was brought to my attention where a new process had been introduced. The superintendent told me that the gas produced had varied from six to 30 candles, and had made lots of trouble among consumers

In another case the gas furnished at times was all coal gas, at other times all water gas, and sometimes was part one kind and part another. It seemed to me that the trouble this latter company experienced with its consumers was largely owing to this cause.

The rustic who comes to the city for the first time, born and bred far from the "maddening crowd," and accustomed to a tallow candle or a cheap kerosene lamp, is dazzled and almost blinded by the brilliancy of a modern lighted city. The quantity of light is so unusual that he makes no account of any lack of uniformity.

Your city man, on the contrary, is a critic, and a severe one, when he deals with gas matters.

He will give you a rap whenever he can through your collectors or the daily press. Praise he will never bestow upon you; but good gas, of uniform quality, will be least liable to his censure.

Having finished reading his paper, the author thus continued—

My time was limited for preparing this paper, and I would like to explain at greater length the comparison I made with regard to gas and electric light. It seems to me to be a fact that we are able to keep our gas within closer range of candle power than any other known substance used for lighting. The gentlemen present who attended a lecture* given by President Morton at the Stevens Institute, Hoboken, N. J., before this Association some years ago, will remember the beautiful illustration he gave us by throwing the arc light upon the stereopticon, which made it very apparent why this unsteadiness of the arc light exists, and I do not know it has been entirely remedied. The defects that an electric engineer must overcome in order to keep his candle power steady, as I understand them, are not only the volume of electricity, but the intensity that is furnished to any given lamp. It is also a fact that the particles of carbon, as they are burned, are torn off irregularly from the carbon pencil. In the illustration given by President Morton the ends of those carbons were extremely beautiful. They had the appearance of the top of a mountain covered with snow. As the light played from side to side it would appear like a mountain on one side, all shaded, but the shadow would pass to the other side, showing that these particles of carbon were being torn off at frequent intervals. In the incandescent light the trouble seems to be of a different character. Of course, the question still arises as to the quantity of electricity required to produce the light, and the intensity. The trouble that I have observed in all companies that I am connected with (notably at Woburn, Massachusetts) is that the lamp itself degenerates. We do not observe this in a great city like New York; and there are two or three reasons why we do not observe it here. One reason is that all the apparatus used for the purpose of producing incandescent light is new, and the various manufacturers are naturally very ambitious and anxious that their light shall make a good show here so that they may introduce it elsewhere. There is another reason—they can employ special electrical talent here; and it does not so much matter to them here what the light costs. In

*See JOURNAL, Jan. 2 and 16, and Feb. 3 and 17, 1879.

order to get at what the incandescent light will do on the average, you must go to some small place, like Woburn, for instance, which is still a town, although it aspires to be a city. There we find in practice that the electric light company, which is competing with the gas company, is offering to supply electric light to any store at the price of gas. The first lamps they put in give a 20-candle light, which is better than our gas light, the latter averaging from 16 1-2 to 17 candles. But the character of that electric light gradually degenerates, until it gets down to 8 or 10 candles; and there it stays. That amounts to a serious fluctuation in the long run, and is a matter which, in the hands of outside companies (not gas companies, who have studied this subject in the way of looking after their consumers and rectifying evils) amounts to an evil sure in the long run to be very vexatious. If you will take the readings of your photometer often enough, after your gas is ready to go into the holder, and see to it that your consumers are not using worn-out and wasteful burners—a matter that every company ought to look after—then I make the claim that, month after month, and year after year, we have, in gas, a more uniform lighting value than can be shown in any other known method of artificial illumination.

On motion of Mr. King a vote of thanks was tendered Mr. Monks.

The President—As the next two papers to be read are on kindred subjects we will hear them both read before we discuss them.

Mr. O. B. Weber, of New York city, read his paper entitled:

## DEVELOPMENT OF THE HALF-DEPTH REGENERATIVE FURNACE, AND SOME OF THE RESULTS.

Firing retort benches with gaseous fuel has occupied the attention of the gas world for the past 25 years. As practical results of these labors the various regenerative systems show how much ingenuity and scientific learning has been expended. The first attempt to fire with a regenerative adjustment in this country was made at the 42nd Street Station of the Consolidated Gas Company, New York city (known then as the Metropolitan Gas Works), and was due to the progressive and enthusiastic ideas of the President, Mr. O. Zollikoffer. The form of furnace used was the Liegel, or Slit, which enjoyed at that time the privilege of being the first regenerative furnace tried in this country. This system, through the untiring and zealous devotion of the late Mr. Herzog, the engineer of the works, after several alterations, made necessary by the difference in the fluxing quality of European and American coke, has maintained itself at these works with great success. The next departure was the substitution of a grate furnace for the slot, suggested by Mr. Alexander Strecker, engineer of the works at that time. This change showed conclusively that, as far as this country was concerned, the most successful furnace would be one with a grate. This was the turning point in the use of this system. It became apparent now, through the successful operation of these furnaces that, if not too costly in construction and elaborate, nor requiring any more than ordinary care to run them, they would become valuable adjuncts to small gas works. It seemed a comparatively easy matter to translate a Liegel furnace to any gas works in the country. In one's mind, perhaps, this was so; but, practically, alas! What insurmountable and fearful obstacles were in the way! My friend, Mr. Baxter, had low retort houses and chimneys; Mr. Sherman was not able to excavate any distance below, owing to attraction of the waters of the Sound; another well-known gentleman discovered an iron spring bubbling forth in one of his arches, after digging down a few inches below the floor-line, and so I might multiply the cases, almost *ad infinitum*. It was all very well to speak of raised iron floors and charging platforms; but fate, in the shape of a stern Board of Directors, often withheld its sanction, scared by the increased cost of building. It was necessary in order to obtain the advantage of regenerative firing, to construct a furnace possessing all the cardinal features of the large one, without its elaboration or depth. Opportunity soon offered itself, through Mr. A. C. Wood, of Syracuse, N. Y. The half-depth furnace placed in his works was the first trial of this system. It possessed all the features of a large furnace together with its weak points. The air for primary combustion was taken in directly under the grate bars, without previous warming. The height of the combustion chamber was very small, so that scarcely any very important results could have been looked for from it. Still, it served as a guide; and subsequent trials show that the lines of construction as laid down in that furnace were correct and permanent. The practical application, now, of this system on a larger scale—*i. e.*, under many benches in one stack—was made at the works of the Williamsburgh Gas Light Company, Williamsburgh, N. Y. The enterprise of Mr. C. W. Blodget made this trial possible. A stack containing 20 benches of six retorts each was erected. The details of this plant may interest the gentlemen of the Association. To begin with. The depth below the floor-line is 30 inches. The arches are 7' 6" wide, and 10' long, accommodating retorts 14"x28"x10'. The benches are built back to back, and the draught for them is furnished by one main flue running below the entire length of the stack to a chimney 75 feet in height. This does away altogether with the chimneys on each bench, affording a steady and uniform pressure on each bench. It will be assumed, naturally, in working regenerative furnaces all that is to be done is to fill and light the furnace, then charge the retorts and expect 9,000 to 10,000 cubic feet yield. This is all very nice; but it takes a little persuasion to secure this. Before getting there, however, make up your mind that it will not all be easy work. The presence of clinker, hard enough to build houses on, soon manifests itself. An increased consumption of coke surprises and alarms you. To make matters worse the heats, of whose uniformity and regularity you have been led to expect so much, go down, so that hardly 200 lbs. of coal can be carbonized. Speculations as to the probable cause are numerous, and pet theories are manufactured to suit the case.

Experience similar to this has been frequent, but the causes producing such effects have been discovered, as well as the way to avoid them. In the first place, the passage of the products of combustion through the parallel flues to the chimney is at times interrupted by a hard metallic clinker depositing itself in the last flue. Why it should remain there is obvious; carried around in a highly heated condition, the infusible particles of the coke are in suspension until the vertical, or chimney-flue is reached. Then their specific gravity prevents them from ascending; and, gathering additional volume, soon the most beautiful and exasperating clinker ever seen is formed. To obviate this becomes, then, a prime necessity. This is partially accomplished by heating the primary air supply, as well as permitting it to come to the grate-bars at ordinary pressure. An important feature, also, is the draught on the bench. There must be no rush of air, either primary or secondary; but all of it must go in easily and naturally. In fact, the damper on the bench chimney should not be opened any wider than to insure an easy but constant draught. Since the time this fact was established clinker has troubled us but little. The relation of the supplementary air supply to the primary oftentimes is a perplexing factor to the men in the retort house, or until they have become accustomed to the working of the furnace. It is a safe rule when employing an ordinary bench chimney furnishing through draught, to open the primary air supplies all the way and the secondaries about half. The area of each slide is 25 square inches. When the furnace is once in working order the men in the retort house find no difficulty in running it successfully. At first, they generally express some doubt as to the ability of the furnace, but when they see that it lessens their labor, besides doing away in a great measure with stopped standpipes, there is a rush for the position of fireman. In small works, with an output of only 20,000 cu. ft. per day, the saving of labor to the man in charge is quite a factor. The uniformity of the heats carried, and the comparative ease with which the furnace can be run, invite inspection. The percentage of the saving in coke is much higher than expected, and the average yield per mouthpiece compares favorably with the average results of the deep furnaces. I am indebted to Mr. Blodget of the Williamsburgh Gas Light Company for some of his results obtained during this season's run. In retorts, 14"x28"x10', charges averaging from 280 to 300 lbs. have been burned off every four hours, with an expenditure of about 25 per cent. of the coke made, figuring 40 bushels to a ton. The general averages of the various furnaces in other cities show, besides the marked saving in coke, an increased output per mouthpiece, as well as decrease in the wear and tear of the furnace and retorts. If, perhaps, the half-depth furnace as at present built does not pave the way to "Dollar Gas," it is not the fault of its economizing qualities.

Mr. Fred Bredel, of New York city, then followed with a paper on

## THE ADVANTAGES OF REGENERATIVE FURNACES FOR LARGE AND SMALL GAS WORKS.

Gentlemen of the Association:—Every gas engineer will admit, in a general way, the advantages of regenerative furnaces, but my present purpose is to show to you in a specific way the financial advantages secured by their use. Take, for example, the case of a

large gas works, in which the retort-house is fired under the old system, and that the plant is still in good or perfect working order. To replace it with the improved style of furnace would cause, say, a total loss of that which it succeeded. Assuming that to be so, and the maximum production to be estimated at 1,300,000 per diem, with the total annual output fixed at 300,000,000 cu. ft., such a condition of things would call for a retort-house containing 14 benches of 9's, the cost of which would be about $84,000. At the start, then, we are obliged to charge $5,040—$84,000, at 6 per cent. per annum—to interest account. Now, we could carbonize 60,000,000 lbs. (30,000 net tons) of coal per annum, and have left for sale, at the rate of 1,080 lbs. coke per ton of coal carbonized, 32,400,000 lbs., or (at 40 lbs. per bushel) 810,000 bushels of coke. Under the old system we would not be able to sell more than 700 lbs., or about 17 1-2 bushels, of coke per ton of coal carbonized, or a total of 525,000 bushels. This shows a gain in available coke production of 285,000 bushels. Assuming that the coke is worth only 4 1-2 cents per bushel, the net gain in money is shown to be $12,825.

When using regenerative furnaces one man can make from 30,000 to 32,000 cu. ft. of gas per day, besides bringing in the coal, charging the retorts, attending to the fires, and removing and quenching the coke. This man's services would cost you upon an average, say, $2.75 per day, hence the retort-house labor would figure out at about 8.6 cents per 1,000 cu. ft. On the other hand, in the retort-house fitted with benches of 5 or 6 retorts, fired under the old plan, one man generally makes from 18,000 to 20,000 cu. ft. of gas per day, and also attends to the other duties above-mentioned. At the same rate of wages, therefore, the charge for labor would be about 13.75 cents per 1,000 cu. ft., which shows a gain secured in this item for the improved plan of 5.15 cents per 1,000, equivalent (on the total make of 300,000,000) to the sum of $15,450. Add to the latter the gain of $12,825 from coke sales and we have a total of $28,275, from which we must deduct the interest charge to arrive at the net profit, which figures out at $23,235 per year. In reality when a new improved retort-house is to be constructed with a view to increasing the capacity of the plant, or for an entirely new works also, necessarily the cost would be $84,000, *minus* the cost of a similar house fitted with 30 free-fired benches of 6's, which latter cost would amount to about $60,000, thus showing that actually interest ought only to be charged on the difference, or but $24,000.

Now, as to the other advantages, prominent among which is the greater regularity which can be maintained in the working of regenerative benches. You can at all times adjust them to the required make of gas, and you are independent of skilled firemen. The capacity can be increased at will, in about 2 hours, from say 9 to 10 thousand cu. ft. of gas per retort per diem ; or, on the contrary, can be diminished from 9 to 8 thousand cu. ft. in the same space of time. A greater yield per pound of coal is secured ; the life of the retorts is lengthened, and the cost of their replacement is about 20 per cent. less than in that of ordinary benches—capacity, of course, being duly considered. A pronounced advantage, especially in large cities where ground is expensive, is the gain in increased producing capacity per square foot, which may be stated at from 35 to 50 per cent. over the old style.

Let us next take the case of a small gas works having, say, a maximum capacity of from 60 to 70 thousand cu. ft. per day, with a minimum of about 30,000, and a total capacity of 15 millions cu. ft. per year, the coal carbonized amounting to about 1,500 tons per annum. In such works a regenerative bench of 8's, with a reserve bench of 5's, would be ample for the purpose. These could be put in at a cost of about $6,000, entailing an interest charge of $360. Assuming that 26 bushels of coke (40 lbs. to bushel) were left for sale from each ton of coal carbonized, a total of 39,000 bushels could be disposed of. Under the old firing system the coke available for sale would not exceed 24,000 bushels. We thus secure a net gain of 15,000 bushels, which, at 6 cents per bushel, shows a profit in money of $900 per annum. The savings in labor would approximate to the services of one man for 365 days, plus the services of one day and one night man, each on 200 days of the year, or a total of 765 days. This, at $2 per diem, means a saving of $1,530 per year. Add thereto the money gain in value of coke sold ($900), subtract therefrom the interest charge ($360), and we have a net gain of $2,075 per annum.

The benches could be worked in the following manner. Use a bench of 8's all the year round. In the winter season charge 300 lbs. per retort every 4 hours, or 1,800 lbs. per retort, or 14,400 lbs. per bench in the 24 hours, giving a yield of, say, 70,000 cu. ft. When the consumption is about 60,000 cu. ft. charge the same quantity 5 times in the 24 hours. That can be done by simply shutting off the dampers and keeping the heats down. The yield per pound of coal will be exactly the same, and the consumption of fuel proportionately less.

When sending out only 30,000 cu. ft. per 24 hours but one day and one night man would be required. The retorts having been charged, at 6 P.M., with 290 lbs. of coal, that charge could be drawn at midnight, and the retorts again refilled, the operation being repeated at 5:30 A.M. At that hour the night man, having filled the generator and closed the dampers, can go to his home. He is followed by the day man who tends to the necessary work around the purifying house and the yard, sells the coke, and draws the last charge, the latter will be burned off by, say, 5 P.M., and opens the dampers. At 6 o'clock the bench will again be ready for firing. The consumption of fuel during this time ought never to exceed from 3 to 4 bushels.

*Joint Discussion.*

The President—We have been interested in this matter now for a considerable length of time, and are beginning to get some results which are reliable. The Association would like to hear from Mr. A. C. Wood, as to whether his furnaces have worked as well during the past year as they did before.

Mr. A. C. Wood—I believe I have nothing to add to, or to take from, the previous statement made to the Association with regard to the working at Syracuse of the Stedman-Stanley furnace. It has continued to give us satisfaction, and perhaps we may report an improvement on the reports previously given. As to labor, our experience therewith holds good as to any previous statements. We have improved somewhat in the item of fuel. The ease with which the production can be increased and diminished is a very great advantage. At times of unusually dark weather, contrariwise, in bright weather, we can vary the production of those benches of 6's from 40 to 60 thousand feet (perhaps more than that if we desire) with very great ease, by increasing the draught, increasing the amount of coke in the furnace, and the charges in the retorts.

Mr. Sherman—We would like to have the experience of our President in the use of the regenerative furnace.

The President—My experience was given you, to some extent, in the address read yesterday. My feeling is that if a man gets a first-rate improved furnace working right, he ought to be extremely thankful, for he has been exceptionally fortunate. Every additional flue put in for the purpose of saving waste heat is put in at your own risk ; and there is nothing more embarrassing than to have one of those things crack at an unfortunate moment, and so render your bench almost inoperative. We are at this time putting in a most elaborate setting in our double retort-house, and our benches are doing so well that my impression is there is more going to be done in that way than in any other. There are gentlemen here who have had more experience with thoroughly constructed regenerative settings than I have. We would like to hear what Mr. Nettleton has been doing with his improved setting.

Mr. Nettleton—I hardly want to express an opinion. The furnaces are not working as well as we would like to have them ; but yet I cannot doubt that this is partly my own fault. The heats do not seem to be under my control in the way that they have been in all the other furnaces that I have ever tried. I think, however, and of course hope, that with more experience I will be able to manage them as easily as I have the others. There can be no question about the economy in coke. They have been in operation now for something over four weeks. Just before I came here I had the coke that had been sold from our yard tallied up, and, for 20 days, commencing September 28th—I take those dates simply because on the morning of each day there was about 300 bushels of coke in the yard—176 tons of coal were used, and nearly 28 bushels of coke to the ton of coal carbonized had been sold. This is with benches of sixes. If I can in the future say as much for the heat as I can for the economy of the furnace, it will be eminently satisfactory.

The President—Mr. Harbison has been doing a good deal in getting ready to construct a new retort-house. The Association would like to hear from him as to the result of his investigations in the matter of furnaces.

Mr. Harbison—The time has been devoted to getting ready, and we have not as yet put any retorts into the arches. We are building a stack of five benches on the Stedman-Stanley plan. The President alluded awhile ago to some of the older members of the Association. I may say that some of the older members may remember that a certain New York State gentleman some time ago referred to his retort-house or works as being a model. We went to look at his works and tried to copy the model and to improve upon it. We hope a year from this time to have had some experience in working the benches that we are now building. We will then be able to give you, I trust, some satisfactory results. If we have any success you will hear from us then. I have nothing in connection with it that I could state, except the manner of construction, which would not, of course, be of any interest.

Mr. Nettleton—Our Secretary has had some experience in the matter, and we would like to hear from him.

Mr. C. J. R. Humphreys—The very little that we have done at Lawrence has been in the direction of a furnace in front of the bench. A couple of years ago we felt that we ought to put in improved furnaces on account of the value to us of the coke. Every year we had

to bring coke from Boston. We wanted to save coke, but at the same time did not care to go to the expense of putting in a full regenerative furnace, because our stacks were comparatively new, and to tear them all down to put in full regenerative furnaces seemed too expensive. So we had to find some furnace that we could use without tearing down the stacks. It may be that there are one or two furnaces which could be used in that way, but they were not altogether satisfactory to us. So we worked up something of our own. I think I may say that there are only two peculiarities in those furnaces. With regard to the furnace itself, it stands out in front of the bench, thus avoiding the necessity of pulling down the arches; and, instead of being square or rectangular, it is made in an oval form. My idea in thus designing it was that I felt that in an ordinary rectangular furnace the coke did not get down into and fill up the corners, leaving a chance for the air to get in, or causing air-holes, so to speak, and thus burning the carbonic oxide in the furnace itself. That was the reason why I made the furnace on this oval plan. The other peculiarity is about the flues. I can best describe them as being a pipe inside of a box. The pipe is the smoke flue, and the space between the outside of the pipe and the inside of the box would be the air flue. It is just like a fire clay pipe in a fire clay box. My idea (and I make the confession that I got the idea from a water gas apparatus) was that the smoke coming down, as it goes over the side, and then comes down into the flue—the flue being round—would cause the gases to travel more greatly in a whirling motion than would be the case in an ordinary straight flue. Whether it is so or not, I do not know. Those are the only peculiarities of the furnace. As to our working with it I must say it has done better than we expected. We have had no trouble from clinkering, and from the first, the furnace has worked very easily indeed. I expect to put in some more next year. I hardly know of any change that I want to make. As we only have two of the furnaces, in our retort house of twelve benches, of course I cannot give you any complete results stretching over any period of time; but I did collect the figures for a week lately, keeping an account of the amount of coal burned in those benches, and of the amount of coke used. The amount of coke used was obtained simply by keeping an account of the number of retorts of coke used, so as to avoid any conflict in items with regard to the measurement of the coke. On the first day our weight of coal per retort charge was only 254 pounds; on the next day, 292 pounds; and on the third, 304 pounds. The percentage of coke used varied, but averaged at about 20 per cent. During the last two days it ran along at 20 per cent. I should say that the retorts, instead of being a full nine feet, only measure about 8 ft. 4 in. on the outside. Of course, 8 inches of very valuable space is lost, otherwise we might possibly do a little better.

Mr. C. Nettleton—Can Mr. Humphreys give us the diameter, and height of the chamber?

Mr. Humphreys—The short diameter is 1 ft. 11 ins., the large diameter being 3 ft. The height is about 5 1-2 or 6 ft. I have here a detailed statement of the workings from October 1st to October 6th:

*Results from two of Humphreys' Furnaces—Lawrence Gas Works.*

| Date. | Coke used, bench No. 7. | Coke used bench No. 8. | Lbs coal carbonized, benches Nos. 7 & 8. | Wt. coal per retort per charge | Per cent. coke, bench No. 7. | Per cent coke, bench No. 8. |
|---|---|---|---|---|---|---|
| Oct. 1 | 8¾ retorts | 8 retorts | 18,300 | 254 | 24.4 | 22 |
| " 2 | 8⅞ " | 8⅞ " | 21,000 | 292 | 23.3 | 23.3 |
| " 3 | 9⅛ " | 8 " | 21,900 | 304 | 23.3 | 22.6 |
| " 4 | 8⅝ " | 7⅞ " | 21,900 | 304 | 24 | 21.7 |
| " 5 | 8⅞ " | 7⅞ " | 21,900 | 304 | 23.3 | 20 |
| " 6 | 8⅝ " | 7⅞ " | 21,900 | 304 | 23.3 | 20 |

N.B.—Percentage of coke is in volume. Retorts, 14″x26″x8′ 11″.

On motion of Mr. Wood a vote of thanks was tendered to Messrs. Weber and Bredel.

Mr. J. L. Hallett, Springfield, Mass., read a paper on

## THE USE AND VALUE OF COKE FOR GENERATING STEAM.

Gentlemen: The Springfield Gas Light Company have used their surplus coke for steam heating since 1878. At that time, 1,792 feet of three-inch pipe was laid as an experimental line, connecting the boiler with the company's office, also several stores, offices and dwellings, the space heated aggregating 145,000 cubic feet.

Steam was generated in a 4x16 tubular boiler, with 60 three-inch tubes. There was 12,526 bushels of coke used, being 2,840 bushels in excess of the previous year, when steam was made exclusively to run the exhauster and for general use about the works. The results were satisfactory financially, and especially in providing a medium for the dispensing of a large accumulation of coke. Since 1878 extensions have been made to the steam heating plant and additional boilers erected. Last winter 5,358 gross tons of fuel were consumed, which is equivalent to 294,000 bushels of coke. That is two-thirds more than our surplus coke, and having used bituminous and anthracite coal of different grade and size, both separately and mixed, it has given opportunity for comparative tests, and we unhesitatingly affirm that coke is the best fuel for producing steam—unless it be crude oil, with which we have not had any experience.

To obtain a given result we found that coke is superior to anthracite (egg size) coal by 10.8 per cent. Compared with buckwheat and pea coal, mixed with bituminous slack, coke will evaporate the same quantity of water with 26.9 per cent less fuel. Our records show conclusively the superiority of coke over coal for making steam. Without advocating the erecting of a steam plant, as that must depend largely on the location of the gas works and cost of reaching the consumer, it may be of interest to know that 250 horse-power could consume the surplus coke of a 5,000 ton gas plant.

Under ordinary conditions a gross ton of coke would evaporate 15,680 pounds of water, which is equal to 10,453 meter units of heat (evaporating 1,500 pounds of water to 1,000 meter units).

Reduced to dollars and cents, on the basis of seventy-seven cents per 1,000 units, a ton of coke would produce $8.04 worth of steam, less 10 per cent. loss in distribution—net, $7.24, or 13.1 cents per bushel used under the boilers.

By utilizing the waste heat of the retort benches to heat the feed water, we have a saving of 100 tons of coal for each bench.

A prejudice exists among some against the use of coke on account of a *supposed* damaging effect on the grate bars and tubes of the boiler. That is not true, in our experience. We have used coke exclusively under one boiler since 1870. Continuous use, day and night for eight months in the year, and careful inspection find it in as good condition as other boilers fired with coal. The grate bars have not been renewed and are apparently in as good condition as when they were set.

Bearing on the subject of the value of coke for making steam, I submit the following anwers from persons that have given the subject their attention:

No. 1.—"A factory tried coke under one of their boilers, and found that it took an equal weight of coke or coal to do the work; but as coal cost $6.25 per gross ton, and coke, at 8 cents per bushel, but $4.96, they saved 20 per cent. and continued the use of coke."

No. 2.—"When it has been used it has been invariably estimated as the cheapest fuel. It has been difficult to supply the demand for such use."

No. 3.—"A company used six tons of hard coal under their boilers in one week. The next week they used coke against the protest of the fireman, and burnt just seven tons."

No. 4.—"Likes it better than anything he ever used; prefers it to any other fuel, as it makes steam faster, and is cheaper than any kind of coal."

No. 5.—"Number 5 says that coke at 10 cents per bushel is cheaper to him than coal at $7.00 per ton."

No. 6.—"A prejudice formerly existed in this place against coke for firing boilers. It was claimed that coke injured the boiler and setting; but such prejudice, born of indolence, has long since passed away. Can sell all the coke made to users of steam."

No. 7.—"Our experience has been that the use of coke does not damage the iron of the boiler."

No. 8.—"Have used coke 25 years under a boiler at gas works. It has been in constant action, and apparently is in good condition."

No. 9.—"Nothing used but coke, eight to nine years, and boiler now in perfect condition."

No. 10.—"Over 15 years continuously, night and day."

No. 11.—"Used coke under boiler for 10 years, the boiler being in use 24 hours each day."

*Discussion.*

Mr. Bredel—Did the gentleman find any difference between the use of hard and soft coke—that is to say, coke produced by high and low heats?

Mr. Hallett—No difference at all. We have been supplying steam now since 1878, and one 45-horse power boiler consumed 50 tons the first year. Our business has grown to 1,000-horse power, with the consumption last year of 5,200 tons. We have used all kinds of fuel, and in all ways. Considering that the Lehigh egg coal was the best we could obtain, we tried 100 tons of the same, compared it with coke, and found the result to be in favor of the latter, on what we supposed was the best coal that we could possibly use. We also used soft coal and the small sizes of Lehigh coal, but every test made showed that we could make more steam with coke than with coal. We run our retorts at high heats, and our yield of gas per lb. of coal carbonized will average, throughout the year, 5 ft.

The Secretary—The following tables, handed to me by Mr. A. E. Boardman, contain a report of the results at the pumping station of the Macon, Georgia, water works:

TABLE No. I., showing comparison of coal (bituminous) and coke as fuel consumed in the Waterville pumping station of the Macon (Ga.) Water Works. Average steam pressure, 70 lbs.; average water pressure, 100 lbs. Pump, a Worthington Compound Duplex, 12 in. by 20 in., by 10 in. by 15 in.

| Date, 1885. | Water pumped, gallons. | Fuel used, lbs. | | Waste, per cent. | Duration of test. | Gallons pumped per lb. fuel. | |
|---|---|---|---|---|---|---|---|
| | | Coal. | Coke. | | | | |
| April | 14,728,000 | 68,974 | ..... | 7.79 | 30 days | Av'age 270.68 | |
| May | 17,102,000 | 74,448 | ..... | 6.35 | 31 " | | |
| June | 19,084,000 | 71,628 | ..... | 7.62 | 30 " | | |
| July | 21,746,000 | 75,012 | ..... | 7.52 | 31 " | | |
| Aug. | 21,875,000 | 75,858 | ..... | 7.43 | 31 " | | |
| Sept. | 21,049,000 | 78,481 | ..... | 7.34 | 30 " | | Av'ge duty |
| Oct. | 21,715,000 | 72,870 | ..... | 7.65 | 31 " | | 41,699,000 |
| Nov. | 20,282,000 | ..... | 93,060 | Av'ge 19.7 | 30 " | Av'ge 295.74 | |
| Dec. | 17,273,000 | ..... | 67,330 | | 31 " | | |
| 1886 | | | | | | | |
| Jan. | 19,192,000 | ..... | 87,580 | | 31 " | | |
| Feb. | 16,780,000 | ..... | 67,640 | | 28 " | | Av'ge duty |
| March | 15,719,000 | ..... | 63,050 | | 31 " | | 37,036,000 |

Taking the value of coal to be 100, the above shows coke to be 87.

TABLE No. II., showing further tests with the same pump. Steam pressure, 60 lbs.; water pressure, 68 lbs.; duty, 32,148,000 gals.

| Date, 1886. | Water pumped, gallons. | Fuel used, lbs. | | Duration of test. | Gallons pumped per lb. coal. | Gallons pumped per lb. coke. | Waste, per cent. |
|---|---|---|---|---|---|---|---|
| | | Coal. | Coke. | | | | |
| May | 3,038,080 | ..... | 15,625 | 94½ hrs. | ..... | 194.45 | ..... |
| " | 4,207,280 | Mixed, | 18,421 | 133 " | 228.40 | | .... |
| " | 12,911,940 | 41,800 | ..... | 415 " | 309.73 | ..... | 8.91 |
| July | 5,605,740 | 19,200 | .... | 9 days | 291.92 | ..... | ..... |
| " | 12,842,700 | ..... | 51,640 | 18 " | ..... | 248.70 | 12.56 |
| " | 3,359,900 | Mixed, | 12,400 | 4 " | 270.72 | | ..... |
| Aug. | 7,922,820 | ..... | 36,780 | 11 " | ..... | 215.41 | ..... |
| " | 10,167,040 | 39,200 | ..... | 12 " | 259.62 | ..... | ..... |
| " | 6,245,760 | ..... | 30,580 | 7 " | ..... | 204.24 | ..... |
| 1887 | | | | | | | |
| Jan. | 18,055,620 | 61,200 | ..... | 19 " | 295.02 | ..... | ..... |
| " | 9,729,900 | ..... | 41,120 | 12 " | ..... | 236.62 | ..... |

By these tests we find the value of coke to be 77, taking coal as 100; and a mixture of about equal quantities to be 82 1-2. A fair estimate would be, coal, 100; coke, 80.

Mr. C. Nettleton—What sort of coal is that from which Mr. Boardman obtained his coke? Of course some coals contain more ash than others, and that might make a difference. The South Alabama coal might give different results from Pittsburg coal.

The Secretary—The document does not show that. It simply shows that the coal against which the coke is compared was bituminous coal.

Mr. Helme—I know that Mr. Boardman gets his coal from Tennessee, near Chattanooga.

On motion of Mr. Sherman a vote of thanks was tendered to Mr. Hallett for his paper.

### Appointing the Committee of Investigation.

The President—Is Mr. Taber ready to report the names of the proposed Committee of Investigation?

Mr. Taber—At the request of the members of the Committee, appointed for that purpose, I report the following names: Frederick S. Benson, Brooklyn, N. Y.; Charles F. Prichard, Lynn, Mass.; T. Littlehales, Hamilton, Ontario; James Somerville, Indianapolis, Ind.; A. E. Boardman, Macon, Ga.; Wm. J. Fay, Denver, Col.; and J. B. Crockett, San Francisco, Cal.

The President—The Chair awaits a motion.

Mr. Harbison—I move that the report of the Committee be accepted, and that these gentlemen be declared the Investigating Committee, in the expectation that every man will perform his duty. [Adopted.]

### Supplementary Reports from Executive Committee.

The President—Mr. McMillin wishes to present reports on two additional matters referred to the Executive Committee. The members of the Association may remember that last spring a donation of 5 pounds sterling was sent by a Scottish gentleman to the proprietors of the American Gas Light Journal, to be devoted in such way as they thought best for the interest of the fraternity on our side of the Atlantic. The Journal folks turned the money over to this Association, and the Association turned it over to its Executive Committee, who are now ready to report, through Mr. McMillin, a recommendation in regard to the disposition of the sum named.

Mr. McMillin—I think we have had no question harder to wrestle with than this. We finally determined on our report only within the last few minutes, which is as follows:

"The undersigned were appointed by the Executive Committee to take into consideration a communication received by the American Gas Light Journal from a resident of Scotland, who desires that his identity be concealed under the title of 'An Old Scottish Subscriber.' In this communication the donor desired to convey to the American gas fraternity a slight token of his esteem in the shape of a draft for five pounds sterling, to be used or disposed of in such manner with any of the gas associations in this country as the editor of the Journal might suggest. The Journal people have kindly suggested that the Association offer this money (about $25) to the best paper on some subject to be selected. Your Committee suggest that the Association offer this as a premium for the best paper on the subject of 'Naphthaline,' the paper to be read at the next meeting of this Association.

"They further suggest that the Secretary convey to the donor the thanks of the Association for his generous offering.

E. McMillin,
W. H. White,
J. P. Harbison, } Committee."

On motion of Mr. Sherman, the report of the Committee was accepted, and the disposition of the money recommended by the Committee approved.

The President—Does the Executive Committee couple with that any suggestion as to who shall be the judges?

Mr. McMillin—No; they leave them to be appointed at the next meeting.

### Publishing the Proceedings.

Mr. McMillin—The same Committee had another question before it—that of the publication of our proceedings—a subject which has become something of a chestnut. The Executive Committee feel that the question must be met at this meeting, in deference to the parties who are interested in the matter. We have made our decision and I will announce it, but I will have to reduce the report to writing after I have made it orally:

It is the sense of the Committee that, in the future, the Association should employ its own stenographer, make its own report, and furnish copies of that report to all of the gas journals willing to pay their pro rata share of the expense. In short, that is the substance of their recommendation.

Mr. Clark—I move that the report of the Committee be accepted and adopted.

The President—You have heard the report of the Committee, recommending that for future meetings of this Association the stenographer be employed by the Association instead of by the American Gas Light Journal, and that the report of the proceedings of the Association be then furnished by him to all the journals that are willing to pay their proportionate part of the expense of his employment.

The motion of Mr. Clark was agreed to.

### The Toronto Meeting.

Mr. Pearson—As I was not here when it was decided to accept the invitation (tendered by the Toronto Gas Light Company), to the Association, to hold its next meeting in that city, I wish to take this opportunity of expressing my gratification with your action, and my appreciation of the honor you do us by meeting there. I hope that at the conclusion of the next meeting of the Association no member will have reason to regret the acceptance of the invitation.

### Printing the Papers in Advance.

Mr. A. C. Humphreys—I move that at the future meetings of this Association the five papers to be read, as designated in advance by the Executive Committee, be printed by the Secretary in time for distribution among the members at the opening of the session; and that the Executive Committee take the proper action to insure the completion of those papers long enough in advance of the meeting to permit them to be printed. In making that motion I would say I do not believe this will make it any harder for any member to prepare his paper. Although I put off preparing my paper until last Friday, I could have written it just as well a month ago—perhaps a little better—if I had been compelled to do it at that time. [Adopted.]

### The Gas Interest in England.

Mr. Nettleton—If there is no other business now before the Association, I, for one, would be very glad to hear from Mr. Spice as to how gas matters are in England.

Mr. Spice—Mr. President and gentlemen: If I had received notice that such a question would be asked me, I would have prepared myself to answer it in a proper manner; but in default of such intimation you will have to take whatever may happen to come into my mind. I may say that the English gas industry is in a prosperous condition, notwithstanding all the efforts of the electricians of the world, who find their way to London as well as to the United States. It is an axiom that it is safer not to prophesy until you know what is before you; but about eight years ago, when a bombastic message from America arrived in England to the effect that the gas industry was doomed, that the gas works of the world were to be covered with a pall such as that which descended many centuries ago upon the old city of Pompeii, that we were to be covered up and never more seen, that the place that knew them then should know them no more, I ventured, at that desperate epoch in our business, when the holders of gas stocks were frightened almost out of their senses, to prophesy that the advocates of electric lighting would prove to be blessings in disguise. And so it has turned out. The

rate of progress, of development—or call it what you will—the rate of the growth of the consumption of gas in England has been about nine per cent. per annum. I understand that greater things are done in America, in the way of progress, than in England. In America, a city beginning with but a thousand people, will, before you really know where they are, become a city of 50,000 inhabitants. If you make allowance for that very rapid growth of population (of which we know comparatively nothing in England), you will see that gas matters in England and in America have gone hand in hand, from prosperity to prosperity.

Why has electric lighting proved to be (as I ventured to prophesy many years ago it would be) a blessing in disguise? Why, sir, it is because we are all of us the better for being stirred up to greater exertions by some kind of stimulus which acts, perhaps, upon our brains through our pockets. We are thereby stimulated to greater exertions, to making greater efforts in the direction which we think will tend toward our prosperity. That is a general truth not admitting denial. It did act in that way in respect to the gas industry of England, and it has acted in that way upon the gas industries of this great and glorious country. Men who were once accustomed to a glimmering light, and who could, by getting near enough to it, manage to read the newspaper, or conduct ordinary business, when once made familiar with the light of a great industry were so influenced by it that the greater light eclipsed the lesser, as great lights always will. It led to the necessity for five, six, seven, and eight feet per hour in the burners of the public lamps, instead of the miserable three feet rush-light concern which, through the penuriousness of the parish vestries, the people of London once had to be content with. Formerly the gas lights in the streets of our towns in England were just sufficient to make darkness visible; and I have often said that if a thief in a London street wanted to hide away from the police, the most secure place to which he could go was to step into the shadow of a lamp. That may sound somewhat strange to you, but it is a fact that he would have been sufficiently obscured by the shadow cast by the gas light. Where three feet of gas formerly sufficed, it is now the fact that five times three feet are used. There was an increase of consumption at once upon the introduction of electric light; but with the increase of consumption, and the resultant diminution in price which almost necessarily followed, there was much complaint that the great increase of consumption was accompanied also by an increased degree of impurity—such as gas consumers had not been accustomed to; and this want of purity was bitterly reflected upon by that able American scientist, Mr. Edison, who described the "stinks" as coming up into the room from holes in the floor, or chinks in the wall, or as descending from the burning gas chandelier from the ceiling. But that description (if it ever were true) has now ceased to be the fact. In England we are now tied down to a degree of purity such as was not known until the electric light came. In one way or another, by cheapening the production, by increasing the purity, by applying that stimulus to every department of gas production, and delivery, and by disseminating information of all kinds for the benefit of that great public who are our customers, we have thriven, and are going on to thrive, and have had no check to that development of growth by which we are becoming greater and greater. One thing has tended to maintain the position of the gas companies, and that has been the application of gas as a motive power for the production of electricity. We have had, in the last year, in London, a notable example of that, where a very large hotel, built after the model of your large American hotels, really pay more for gas (after the whole house had been lit with electricity) than they ever did before. There is no economy in electric lighting, so far as they are concerned; but they want it. I have said that electric light is, and always must be, a luxury. It is not the poor man's light; it is the light for those who can afford to pay for it. And that is one of the assurances which we as gas men have that we shall always be able to hold our own. I thank you, gentlemen, for your kindness and attention.

### Back again to the Publication of Proceedings.

Mr. McMillin—Having to make two reports awhile ago it seems that I did not do all that was expected of me. My attention has been called to the fact that I did not make one as full as was intended. I still think that I did; but will state what the Committee wish me to, and then leave the matter for the Association to settle. The Committee instruct me to report the recommendation that the resolution (passed some years ago) making the American Gas Light Journal the official organ of this Association be rescinded, and that the proceedings be hereafter reported and furnished as I suggested. The Association will employ the stenographer, and furnish copies of the reports to such gas journals as will pay their pro rata share of the expense. Before we could properly act upon the resolution already adopted, the Committee thought it was necessary that the resolution formerly passed, making the American Gas Light Journal the organ of the Association, should be rescinded.

The President—As that is a somewhat different motion from the one already put, I will have to put the question to the Association again.

Mr. Nettleton—I sincerely hope the amendment now offered by Mr. McMillin will not pass, and I say so from motives of personal kindness toward Mr. Thomas, who is now so sick that he is confined to his bed. Personally, although I was sorry to see it adopted, I was content to have the previous resolution decided without protesting against it. I would, however, be very sorry to have this action added to that.

Mr. Wood—I quite agree with the remarks made by Mr. Nettleton. I believe it would be a very unjust and ungenerous act on the part of this Association to pass a resolution of the kind proposed. If not directly, it is certainly indirectly reflecting upon the conduct of Mr. Thomas, an old and honored member of our Association. I sincerely hope the recommendation of the Executive Committee will not be approved.

Mr. Graeff—As one who is, perhaps, as much interested in this matter as any one else, I wish to say I trust the matter will be allowed to remain as it is. If Mr. Thomas were present I might not take this position; and I confess the fact of his absence did not occur to me when I asked Mr. McMillin whether the Committee's report, as made, covered all the matter of their recommendation. I, therefore, if it is proper to do so, ask the Committee to reconsider its report, and to limit it to the recommendation already made and acted upon.

Mr. A. C. Humphreys—I ask if the passage of the first resolution is not, in effect, the same as if we passed the resolution now suggested.

The President—Not exactly.

Mr. Brown—I wish to say I heartily agree with what Mr. Graeff has stated.

The President—We have now heard from the editors of the other papers having an interest in this matter. I hope the resolution which constituted the American Gas Light Journal the official organ of this Association will not be rescinded. Under the circumstances, will the Committee withdraw the resolution or shall we vote it down?

Mr. McMillin—As chairman of the Committee, of course, I have no authority to withdraw the resolution which they instructed me to report. I thought the first resolution virtually covered it; but some of the gentlemen of the Committee insist that it did not. I cannot withdraw the resolution, for I have not the authority to do so—whatever my personal feeling may be upon the subject.

Mr. A. C. Humphreys—I would like to ask how the American Gas Light Journal can remain the organ of this Association if the original motion is passed.

The President—The question has been raised as to whether this covers the question of the notices which are sent by the Secretary of the Association to the Journal, and which are published in it. I would ask the chairman of the Committee whether, in his judgment, the notices are hereafter to be sent to the other journals, or are only to be sent to the paper which has heretofore published them.

Mr. McMillin—I have only made the report as I was instructed to make it by the Committee. If you want to know any further as to what that report means, I shall have to ask you to take the understanding of the Committee with regard to it.

Mr. Clark—But the Committee were discharged, by vote of the Association, after having made their first report.

Mr. A. C. Wood—As I understand the matter, the American Gas Light Journal, as the official organ of the Association, has heretofore had its stenographer here to report the proceedings of the Association, and has done so without any expense to the Association?

The President—Yes.

Mr. Wood—And the recommendation of the Committee is that hereafter the Association employ its own stenographer, and publish the proceedings in such papers as may desire to print them.

The President—Copies of the report are to be furnished by the stenographer to such papers as are willing to bear their proportion of the expense.

Mr. Wood—The effect of that would be to take the entire matter out of the hands of Mr. Thomas, our old friend and honored associate. I appeal to the leniency of the Association, and to the forbearance of the Committee. I move that the motion to accept the recommendation of the Executive Committee be rescinded.

Mr. Helme—I second that. I do not think that an old member of this Association, one who has been with it from the beginning, can fail to recollect how the American Gas Light Journal has always stood by us, and rendered all the aid possible in the promotion of the interests of the Society, and in the protection of the gas business generally. I have, on one or two occasions, made a movement toward having the Journal paid for the great expense they were at in publishing the proceedings, but the publishers of the Journal have refused payment every time. Now, if that conduct on their part—if that treatment of our Association, is not worthy some consideration at our hands, especially from the older members, then I must say that good treatment goes for nothing. I for one, as a member, shall be very sorry indeed to see the thing changed from the course which has been followed for some time past—from a time, in fact, when it was very doubtful whether this Association could be made a success. I can recollect very well, when, in this city, Mr. Steel, of Buffalo, moved that this Society take steps toward its dissolution. But that resolution did not pass—thank heaven!—and we are here to-day under prosperous circumstances. I do not know from what source we got more or better aid in attaining our present prosperous condition than we got from the American Gas Light Journal, and I do think something is due to them in consideration for the great help they then gave us. They at least deserve good treatment at our hands. Let us not cast them aside as we would an old horse for which we have no further use.

Mr. Floyd—As one of the old members of this Association I can second everything that Mr. Helme said. I think we ought now to stand by the American Gas Light Journal, for it stood by us in our adversity. It deserves our assistance now.

The President—A motion is made by Mr. Wood that we reconsider

the vote by which we resolved hereafter to employ our own stenographer.

Mr. Wood—My motion was to rescind the previous action.

The President—It amounts to the same thing. The motion to reconsider is the proper parliamentary rule.

Mr. McMillin—I do not know whether the other two members of the Committee are in the hall or not to speak upon this motion—

Mr. White—I am right here with you, McMillin.

Mr. McMillin—There has been a good deal of dissatisfaction expressed that the Association should father one journal to the exclusion of all others; and the Committee has endeavored to consider this question from all its various standpoints. I do not believe that any of the gentlemen who have spoken upon the other side of the question, and against this report, entertain any higher opinion, personally, of Mr. Thomas, or of the managers of that paper, than do the members of this Committee. (Applause.) They have received favors from him; they are all under obligations to him; they are all his personal friends. But, I think it would be in just as good taste for an old gas engineer of twenty or thirty years' experience, to come into this Association and ask us to protect him against the rising young fellows who are coming up every day, as it is for the American Gas Light Journal to be always asking the support of this Association, as against its competitors. Certainly, there is no feeling on the part of the Association against the Journal—it has been the friend of us all, at all times; but other papers are now struggling for existence, and they are doing their duty and are doing it well. I see no reason why we should deny them what we give to the secular press. Other associations permit the publishers of the daily papers to attend their meetings, take notes of the proceedings and publish them. If they send a shorthand reporter he can take down the papers which are read, and they can be published also. That course has not been followed in this Association. We have given to one journal the exclusive privilege. I am opposed to rescinding what we have already done in this matter. We certainly have not done anything more than is fair, and I think Mr. Thomas would admit that if he were here with us.

Mr. Harbison—As a member of the Committee that made this report to the Association, I wish to say I am not willing to stand second to any member of this Association in the expression of high esteem in which I hold Mr. Thomas, and the gentlemen who are connected with him in the management of the American Gas Light Journal. I have never received from them anything but the most courteous attention. I have always entertained for them, and still do, the kindest of feelings, and the most hearty wishes for their prosperity and success. My desire as a member of the Committee (and I know that the same feeling existed with each of the other gentlemen) was simply to perform our duty with reference to the welfare of the Association. We could not permit our personal preferences to influence our action. We could not allow our kind feeling toward the gentlemen connected with the Journal to influence our report. We could not, as a Committee of this Association, make a report which simply expressed our personal wishes with regard to the matter; otherwise our report might have been very different from what it was. As Mr. McMillin has said, there has been for years the growing feeling that the proceedings of this Association should be published in more than one journal. It was only the deference due to that largely expressed wish on behalf of many members of the Association which induced me to give my vote for the action which has been recommended by the Committee. As I have said, I could not in justice to the members of this Association, who have honored me with a position on the Executive Committee, do otherwise than I have done, by agreeing to the report which has been presented by Mr. McMillin on behalf of the Committee. The reason leading to the recommendation by the Committee that the resolution, passed years ago, making the American Gas Light Journal the organ of the Association, be rescinded, was because we did not see, with that vote standing on the records of the Association, how any different action from that provided for by that resolution could be taken by the Association. As long as that vote stood no other action could consistently be taken. The first thing to be done, therefore, was to repeal that vote. If Mr. McMillin had not added that recommendation to his report, the balance of the report would be of no effect. You cannot, in my opinion, pass a vote giving to this Association the right to employ its own stenographer, and call on the various papers that choose to publish this report for their proportion of the cost of furnishing it, so long as that vote stands on record which makes the American Gas Light Journal the official organ. It is stultifying yourself to attempt to do it. I want the Association to understand that fact. We must, in my opinion, reconsider that vote before any other action can be taken which will be of any effect or avail.

Mr. Sherman—Is there any objection to permitting other papers to send their own reporters here to take a record of our proceedings?

The President—Yes. The objection is made by the American Gas Light Journal that they, being the official organ of the Association, alone have a right to publish a stenographic report.

Mr. Sherman—Have the other papers no right to send a reporter here?

The President—They have no right to send a reporter to take a stenographic report. Reporters may come in here and take brief notes, but they cannot furnish stenographic reports to other journals. Nor can the papers which are read here be printed in any other journal until after they have been printed in the American Gas Light Journal. The members of the Association know that sometimes, in the stress of business, it has been a long while before the papers have appeared in the American Gas Light Journal.

Mr. Sherman—I supposed any paper had a right to send a reporter in here to make a report of our proceedings.

The President—No; that has not been permitted.

Mr. Wood—But has there been any vote or resolution against permitting other journals to do that?

The President—The Executive Committee have always understood that it would not be allowed. In fact, my attention has been called, during this meeting of the Association, by the Manager of the American Gas Light Journal to the fact that other reporters were here, and I have stopped them from taking notes. That is just what is the matter.

Mr. A. C. Humphreys—Then it is evident that Mr. Wood, and some of the other gentlemen, have made their remarks under a misapprehension.

Mr. Wood—I think I fully understand the situation; and, with due respect to the report of this special Committee, I still insist upon my motion. I must say I think the thing is altogether wrong, and must have been misconstrued by them. The resolution heretofore passed by the Association makes the American Gas Light Journal our official organ. I do not understand that any action of this Association has ever restricted any other newspaper from sending a reporter here to take down the proceedings of the Association. If there is any such resolution I would like to have the Secretary call attention to it. If this special Committee now propose to divide the reports of our proceedings with the American Gas Light Journal, and with the other two now existing journals, as suggested by Mr. Harbison, what shall be done with the next, and with the next, and so on with all the other journals devoted to our industry which may come up hereafter?

Mr. McMillin—Whatever journal is willing to pay for the report will get it.

Mr. Wood—So long as we have an official organ of the Association I do not see the necessity of giving that preference to any more journals. But I would grant the privilege to other journals of reporting and publishing the proceedings, if they desire to do so.

The President—How about the papers which are read?

Mr. Wood—Let them report those also, if they wish to.

The President—Would you let them have copies of the papers?

Mr. Wood—If they send a stenographer here he may take down the papers as they are read; or, if the writer of the paper desires, he may furnish copies of his paper to the other publishers.

Mr. McMillin—That is just what this Committee proposes to do.

Mr. Wood—It seems to me you proposed to make all the journals "official organs." That is the effect of it.

Mr. McMillin—No; the Committee propose to put them all on the same footing, so far as the publication of the reports is concerned. While the resolution stands as it is, it is not the proper thing for parties reading papers to give copies to other journals than the American Gas Light Journal, our official organ. At least, I have always been governed by that understanding.

Mr. Wood—It seems to me that, as we long ago proclaimed the American Gas Light Journal to be our official organ, it should continue so—at least for the present.

Mr. Sherman—What does the Committee propose to do with the papers which are read? Will copies be sent around to the different offices?

The President—I understand Mr. McMillin proposes that, in the future, the publisher of any journal who wishes to do so, shall have a chance to publish any of our papers as early as the American Gas Light Journal does; and that they shall also have a chance to report stenographically the debates, or to have a copy of the report made by the Association's stenographer, upon paying their proportion of the expense. All the gas light journals of the country, if they like, can hereafter report the proceedings of our Association.

Mr. Sherman—But they cannot all have the papers at the same time.

The President—Certainly they can, if they are printed beforehand.

Mr. McMillin—That will be their business. If they can get the copies, they can publish them.

Mr. Wood—I think this Association, representing the vast amount of capital engaged in the gas business, should have an official organ. I still insist upon my motion to rescind the previous action of the Association in adopting the report of this special Committee.

Mr. Lowe—As I understand it the American Gas Light Journal is still our official organ; and I do not think we want more than one. I do not think the last resolution contemplates that we shall have more than one. If Mr. Wood is willing to permit each journal to send a stenographer to take minutes of the proceedings of this Association, and publish them, then I do not see why we would be any better off by rescinding the motion already passed. It would involve merely the question of letting them contribute to the expense of furnishing the report, and I am quite sure that each one of the existing journals would be happy to pay one-third of the expense, and would prefer to do so, rather than pay the entire cost of procuring a report. So far as the papers read are concerned, they can have those at any rate, inasmuch as they are to be printed.

Mr. Graeff—My opinion of this official organ business is that a report of the proceedings can be furnished by the Association to any paper that wishes it, without at all disturbing the relation which the present Journal sustains to the Association as its official organ. My idea in asking the question I did was to ascertain whether the motion carried with it the publication of the official notices of the

President and Secretary. I understood the President to rule that it did not. I consider that so long as the AMERICAN GAS LIGHT JOURNAL is the sole recipient of the official notices which come from the President and Secretary, it continues to be the official organ. I consider that the placing of the report of the proceedings of this Convention within the reach of other journals does not disturb the official organ at all. I understand that to be the President's ruling.

The President—That is my opinion.

Mr. Graeff—I do not understand that any member of this Association is better posted on Parliamentary law than is our worthy President; and I am quite content to accept his understanding of the effect of the motion which we have adopted. Speaking as the editor of one of the journals, I wish to say I do not care to disturb the position of the official organ. I would not have the official organship transferred from the old journal to my own, for I have no desire for it. But, speaking now as a member of the Association, I believe that we ought to publish our proceedings as widely as possible, so that they may be read by members of all the industries that we represent. I have in mind the case of the Western Architect's Association, which had been confining its reports to one journal. Finally they got tired of that, because, while the journal had a good representative circulation, there were other journals coming up which went into quarters where that journal did not necessarily go, and so they departed from the old custom. Now, instead of having one report published, they permit nine journals to have a report, and any architect who does not get a copy of the proceedings of the convention must be a very sorry sort of chap—if he does not take one paper of the nine. As a member of the Association, I believe we should place the proceedings of this convention and of all our conventions, within the hands of every gas man who reads. On that ground I ask for the support of this report made by the special Committee, if you rule that such further support be necessary.

The President—The motion now before the house is that the action just taken by the Association, in accepting the report of the sub-Committee of the Executive Committee, be reconsidered.

Mr. Wood—That it be rescinded.

The President—The proper motion now is to reconsider. At a later time, when the period within which it can properly be reconsidered has gone by, the proper motion would be to rescind. The proper motion now is to reconsider; and the President so rules. Are you ready for the question?

Mr. Lowe—Let us have a standing vote on that question.

The President—Those in favor of reconsidering the acceptance of the report of the Executive Committee will say "Aye;" those opposed to reconsidering it will say, "No." The Chair rules that it is not a vote. Therefore, the report of the Committee stands accepted.

Mr. Nettleton—I wish that the Chair would state just what that report is, so that there may be no misunderstanding.

Mr. McMillin—The report, as voted upon, was that the proceedings be furnished to those journals paying their proportionate share of the cost of making the report.

The President—But it does not affect the official standing of the AMERICAN GAS LIGHT JOURNAL, as being the organ of this Association. (Applause.)

Mr. Helme—Will the papers which are read be handed as usual to the AMERICAN GAS LIGHT JOURNAL?

The President—I would say they would be entitled to the first copy; and if anybody else wants a copy he can get it.

Mr. Helme—It seems to me that by this resolution that matter is left open. You had better decide that question here and now.

The President—I think that that will arrange itself, because we are to have the papers printed hereafter before they are read.

Mr. Harbison—Do I understand that the report of the Committee, which we have acted upon and accepted, is to the effect that hereafter the Association shall employ its own stenographer?

The President—Yes.

Mr. Harbison—And that the papers paying their pro rata of the cost shall have a copy of the proceedings, and of the papers read?

The President—Yes.

Mr. Harbison—We did not provide that any one journal should have all the papers handed over to it?

The President—I understood Mr. Helme's question to be, not with regard to the report of the stenographer, but with regard to the papers which were read. The stenographer, as I understand it, will furnish a copy of his report to each of the journals, but the papers read will not be reported.

Mr. Harbison—It is well to understand that right here. Are not the papers read considered as being part of the stenographer's report?

The President—They have not been reported by the stenographer heretofore.

Mr. Harbison—But they might be, hereafter, if the Association employs a stenographer. It is simply a question whether he shall make a stenographic report of the papers, or whether the original paper shall be furnished to him.

The President—The chair is open to instruction on this matter. I suppose if a journal wants a copy of a paper it will be able to get it.

Mr. Harbison—I would like to know, for my own guidance, what the proper action will be.

Mr. Gilbert—As I understand it, the papers which are hereafter to be read are to be printed, and ready for distribution at the meeting of the Association.

The President—Some will be printed; all may not be.

Mr. Gilbert—Those which are accepted, to the number of five, are to be printed? As to those papers, of course, the journals wishing to publish them will have copies furnished to them simultaneously?

The President—Certainly.

Mr. Gilbert—This year, as I understand it, the papers must follow the ordinary course, and go to the paper which we recognize as our official organ.

The President—But, if the other journals wish to take copies of those papers after they are printed, they are now at liberty to do so.

Mr. Gilbert—But they may not care to do that after they have been published by the AMERICAN GAS LIGHT JOURNAL.

The President—If I have not correctly stated the views of the Association, or if there is any doubt as to just what is intended by the action we have taken, it would be well to have it stated more explicitly.

Mr. A. C. Humphreys—Then, I move that it is the sense of this Association that the stenographic report referred to by the special Committee is understood to be the report of the entire proceedings of the meeting.

The President—Mr. Humphreys offers a resolution explanatory of the vote previously passed, to the effect that the words "stenographic report," which has already been ordered to be given to all the journals willing to pay their share of the expense, shall be understood to mean a report of all proceedings of the Convention, including the papers which are read. So that any journal may publish all the proceedings, including the papers. There is to be no preference given to any journal as to any of the papers.

Mr. McMillin—Our report is to the effect that we furnish a copy of the proceedings, inclusive of the papers, to all journals willing to pay their part of the cost of making the stenographic report. That was the idea of the Committee.

Mr. Helme—It may take some time to make two or three copies of the papers. In the meantime, is each of the journals to remain out of possession of the papers until these copies have been made and handed to the other journals? Let us see how that thing will work.

The President—You will have to ask the Executive Committee as to that.

Mr. Helme—What I want to know relates to the five papers which are to be printed. I understand that copies are to be furnished to the journals, when they are distributed to the members. How will it be as to the others?

The President—At the next meeting of the Association the papers (five in number) designated by the Executive Committee will be printed before the meeting of the Association, and hundreds of copies distributed. A copy will be given to each journal that wants it.

Mr. Helme—That is all well enough as to those five papers. How will it be as to the others?

The President—The resolution adopted to-day provides only for the printing of the five regular papers. If more than five papers are presented, I would ask Mr. Harbison what he wants to have done with them. My ruling did not apply to those. I do not understand what disposition the Executive Committee wish to make of those other papers.

Mr. Helme—Suppose two or more papers are read after the five regular ones are disposed of. Will the AMERICAN GAS LIGHT JOURNAL have those; or must duplicate copies be made for every other journal?

The President—I will leave that for Mr. McMillin to answer.

Mr. McMillin—The stenographer can make type written copies of those, and they will then form a part of his report.

[The motion of Mr. A. C. Humphreys that "It is the sense of this Association that the stenographer's report, referred to by the Special Committee, is understood to be the report of the entire proceedings of the meeting," was then agreed to.]

### VOTES OF THANKS.

The President—Is there any other business to come before this meeting of the Association?

Mr. Lowe—Before bringing this very interesting and valuable meeting to a close, I think we ought, in justice to our worthy President—our earnest and whole-souled friend, Malcolm S. Greenough—tender him a hearty vote of thanks for his very able and interesting address—the best that we have had, according to my notion, at any meeting of the Association. I think we also owe him a cordial vote of thanks for the very masterly and forbearing manner with which he has conducted the proceedings of this Association. I, therefore, move that such action be taken, and that we spread it in full upon the records of our Association. [The motion was put by the Secretary, and unanimously adopted.]

The President—Gentlemen, I am obliged to you all. At times, I feared that I hurried up your proceedings with rather more alacrity than civility; but if I have given satisfaction as your presiding officer it is a matter of great gratification to me to have done so.

Mr. Harbison—As a member of the Executive Committee it has fallen under my notice, during the past as well as in former years (particularly so during the past year) that the Secretary of this Association has a large amount of work to perform. There are very few of the members of this Association who fully appreciate that fact, owing to their lack of knowledge of the extent of it. They may come in contact with him a number of times, in a very pleasant manner, during the year; but it has come to my knowledge that he performs a very large amount of work in the interest of this Association, of which the members generally have no knowledge. I am thoroughly aware of the very able, earnest and painstaking way in

which the duties of his office have been performed. His report to this Association of the management of our finances would do credit to an able New York banker. He has taken care of them in a remarkably able and successful manner. He has performed all his duties equally well. He is ever obliging, ever good-natured, and never gets out of patience. I move a vote of thanks to Secretary Humphreys for the exceedingly able and efficient manner in which he has performed the duties of Secretary during the past year.

The President—I think the entire Association is ready to second the motion made by Mr. Harbison, and it gives me very great pleasure to put it before you. Those in favor will say "Aye." I will not put the negative of the question, simply because it has no negative side. [Adopted.]

The Secretary—I am exceedingly obliged to all the members of the Association for this very kind expression of their approval; and I am particularly obliged to my friend Mr. Harbison for his kind remarks in moving the question.

INVITED TO ATTEND THE AMERICAN INSTITUTE FAIR.

The President—We have a letter from the American Institute of New York, giving the members of the Association a very cordial invitation to attend the Fair now being held. Complimentary tickets are inclosed, which the Secretary will distribute to those who desire them.

On motion of Mr. Boardman, the invitation and tickets were accepted with thanks.

VOTE OF SYMPATHY.

Mr. Vanderpool—Mr. Thomas, one of our friends, and an honored member, has been sick in bed for some weeks. I think it would be an appropriate token of our respect for him if this Association were to pass a resolution of sympathy with him in his illness. I make that motion. [Seconded by several.]

The President—It is moved that the sympathy of this Association be tendered to Mr. Jos. R. Thomas in his affliction, and that the Secretary be requested to communicate to him that fact. [Adopted.]

Mr. Harbison—Let me suggest that a hearty vote of thanks is due to the Committee of Arrangements who superintended our entertainment at this meeting. Therefore, I move the thanks of the Association to the members of that Committee for the able and efficient manner in which they provided for our welfare. [Adopted.]

The Association then adjourned.

## The Valuation of Oxide of Iron for the Purification of Gas.

Mr. H. L. Greville, Chemist to the Commercial Gas Company, contributed the following to the London *Journal*:

THE recent trial of the *Swansea Gas Company v. Abbott and Co.*, and the subsequent article* by Mr. James Sutherland, have called attention to a subject which is of undoubted interest to all managers of gas-works, and suggests that it would be most desirable to substitute some different method of testing the value of various samples of oxide to that usually in vogue. In other words, the value of any particular sample is not expressed by the mere percentage of water, ferric oxide, and siliceous matter present. What is really required is the actual value of the material for purposes of gas purification, or, what is probably the same thing, the percentage of hydrated ferric oxide which is present. The ordinary analysis, of course, is a certain amount of guide; but not a complete one. The usual analysis will reveal the freedom of the sample, or the converse, from clay and siliceous matter—and will also show the percentage of moisture and the total percentage of ferric oxide—details always necessary in the formation of any opinion as to the merits or demerits of any particular sample; but there remains unsettled the important question as to how much of the total ferric oxide present is in the condition to be useful as an absorbent of sulphuretted hydrogen. It is more particularly with regard to this point that I wish to offer a few remarks; and I only regret that I have not as yet had the leisure to thrash the question out practically.

Firstly, with regard to the method of determining the percentage of hydrous oxide described by Mr. James Sutherland in his recent article. I cannot see how this process can give correct results, more especially as applied to "bog ores." It will be remembered that his process consists in placing a weighed quantity of the ore (presumably dried) in a combustion tube, to which is connected a calcium chloride tube; and after the ore has been heated to redness in a current of dry air, and the products passed through the calcium chloride tube, the increase in the weight of the latter is taken as representing the amount of combined water in the weight of oxide taken for the experiment. Now, this process could only give correct results in the absence of organic matter containing hydrogen—a condition never existing in Irish bog ores, one of the characteristics of which is the presence of peaty matter and vegetable fiber. Pure cellulose—the basis of woody fiber—contains upward of 6 per cent. of hydrogen, Peat has been found to contain from 6.6 to 7.1 per cent. of hydrogen; and if we take a mean of (say) 5 per cent. these five parts of hydrogen would yield, on combustion, 45 parts of water. Therefore 10 per cent. of peaty matter in a sample of bog ore would give, on combustion, some 4½ parts of water; and the equivalent of this in hydrated ferric oxide of the formula $Fe_2O_3H_2O$ would be 44.5. Having given some thought to the matter, I do not, however, despair of a process being available for the correct determination of the percentage of hydrated ferric oxide as opposed to the anhydrous in any particular sample of oxide; and of thus affording a means of exactly valuing the material for gas-works purposes. The reaction which appears most promising upon which to found a process for the end in view is that between hydrated ferric oxide and sulphuretted hydrogen. This action occurs according to the following equations:—

$$Fe_2O_3H_2O+3H_2S=Fe_2S_3+4H_2O$$
$$Fe_2O_3H_2O+3H_2S=2FeS+4H_2O.$$

The former reaction, according to Mr. Lewis T. Wright, predominates. What I wish to call special attention to in the above equations, is that whichever action takes place, one molecule of $Fe_2O_3H_2O$, always reacts with three molecules of $H_2S$, and forms four molecules of water. It is also seen that of these four molecules of water, one is derived from the water of hydration of the $Fe_2O_3H_2O$; and the other three from the union of the hydrogen of the $H_2S$ with the oxygen of the ferric oxide. The process I would therefore suggest is to place a weighed quantity of the dried and finely-powdered sample of oxide in a U-tube (preferably mixing it with some dry neutral material—such as sawdust or cocoanut fiber refuse), then to connect this tube to a carefully weighed calcium chloride tube, and pass a current of dry $H_2S$ until the oxide is saturated. The calcium chloride tube could then be detached, a little dry air passed to displace the $H_2S$, and finally weighed. The increase in weight, divided by four, would give the amount of water present, in combination with $F_2O_3$, in the same token. As one molecule of Fe $O_3H_2O$ in reaction with $H_2S$ gives four molecules of water, the weight of the molecule of $Fe_2O_3H_2O$—viz., 178—would give 72 parts by weight of water; and each part of water obtained would represent 2.472 parts of $Fe_2O_3H_2O$.

I see no practical reason why this process should not be a workable and fairly accurate one. Two things must, however, be taken for granted—viz., firstly, that the composition of the hydrated oxide present in the ore dried at 100° C. is $Fe_2O_3H_2O$; and, secondly, that $H_2S$, does not react with anhydrous oxide. An experiment I have recently made on this point shows that (contrary to general belief) a slight action does occur; but I believe it to be infinitesimal, and that it would not practically interfere with the accuracy of the proposed process.

There is another method of determining the value of any particular sample of oxide for gas purification which should be mentioned; and upon which (granting the two assumptions already stated) a calculation can be made as to the percentage of "active" oxide present. I allude to that proposed by Mr. Lewis T. Wright, and which consists in saturating a weighed quantity of the sample with $H_2S$, and either determining the amount of iron which has become sulphide by a special process, or revivifying the material by exposure to air, and subsequent estimation of the free sulphur in the usual way with carbon disulphide. The proportion of "active" oxide present can then be calculated on the basis that 96 parts of S equals 178 parts of $Fe_2O$ .

There is no doubt that it is getting more desirable every day that there should be some acknowledged laboratory method by means of which the special suitability of any particular sample of oxide to gas purification purposes could be ascertained. Judging by my own experience, there is now a good deal of competition in the supply of oxide to gas works; and the most tempting bait is frequently held out to gas managers of samples at very moderate prices, and guaranteed to contain high percentages of ferric oxide. How much of the total percentage of ferric oxide is available for purification, is, however, generally an unknown quantity; and it is obvious, on a little reflection, that, if samples were submitted to a test capable of distinguishing between the "active" and "inactive" forms of ferric oxide, the opinion formed on a simple determination of the total ferric oxide present might be reversed, and that "the first might be last, and the last first."

Before concluding, I should like to draw attention to an inference which follows upon my experiment on the action of sulphuretted hydrogen on anhydrous ferric oxide. In this experiment a small

*See *ante*, p. 232.

quantity of the Gas Purification Company's oxide was ignited for some time, until all organic matter and water was expelled. The residue was then finely ground, mixed with sawdust, and the mass slightly moistened and placed in a tube. A current of $H_2S$ was then passed, and blackening ensued, unaccompanied by any rise of temperature perceptible to the hand. The temperature of the mass had, however, risen (as shown by a thermometer) by about 15° Fahr. Now, once admitting that a slight action had taken place, the inference is that, on revivification and use a second time, the ferric hydrate formed from the oxidation of the sulphide would come into play, *plus* a further small installment of the anhydrous oxide; and thus after a time a material proportion of the anhydrous material would become efficient as an agent for gas purification. Does not this throw some light on the experience of so many gas managers with particular samples of oxide, which do not appear to work well until after being some time in use, and after having, consequently, undergone several sulphidings and revivifications? It would, in fact, seem that even anhydrous ferric oxide is not altogether devoid of power as a purifying agent, if employed in a finely-divided condition; but its action is not sufficiently expeditious to render its emloyment desirable where the active and hydrated material is so easy available. This is more particularly the case as the anhydrous ferric oxide is often hard and massive, so that even if active, its action would be limited by its general imperviousness, unless previously ground very fine and mixed with a large quantity of sawdust or other material to make it pervious to the gas; whereas most samples of hydrated oxide are comparatively light in structure, and readily broken. In the best Irish bog ores, we have the perfection of material as far as physical condition extends; for the ferric oxide is in a finely-divided condition, in a pervious peaty basis. There is also every reason to assume that, in carefully selected and collected samples, a large proportion of the total ferric oxide present is in the hydrated, and, therefore, active condition.

Finally, I will only add that I hope soon to be able to find time to make some experiments on different samples of oxide now in the market, as a practical contribution to an important question, I have thus far been able to do little but deal with theoretically.

## Saccharin.

Edward D. Graville, F. C. S., in the course of a series of notes on saccharin, says:

The sample to which these notes refer represents, I believe, a portion of the first supply that has been offered to us as a commercial article, and may therefore be taken to represent the same as it at present occurs in commerce. I think it desirable to call attention to this fact, because of the wide difference I have seen in other samples obtained, I think, by special request some weeks ago, and which do not favorably correspond with the sample under consideration, being much more highly colored, and in comparison having a very strong odor. Saccharin now occurs as a very pale yellow, nearly white, amorphous powder, free from grittiness, but giving a distinct sensation of roughness when rubbed between the fingers. It is not entirely free from odor, but this is very slight, and not at all objectionable, reminding one of a very slight flavor of essential oil of almonds. Its taste is intensely sweet and persistent, which in a raw state is followed by a slight harshness upon the tongue and palate. The sweetness is very distinct when diluted to 1 in 10,000. Under the microscope it presents no definite form of crystallization. A temperature of 100° C., even if continued for some time, has no perceptible effect upon saccharin; it loses no weight, and undergoes no physical change. It fuses at a temperature of from 118° to 120° C., and at 150° C. forms a clear light yellow liquid, which boils a few degrees higher. At the latter temperature dense white fumes appear, and a condensation of tufts of acicular crystals (some well defined) is found upon the cool surface of the apparatus. These crystals, except for a slight sweetness of taste, correspond in characters and tests to benzoic acid. The sweet flavor, I think, may be due to the presence of a very small quantity of undecomposed saccharin, carried mechanically with the fumes. The escaping vapors, which are very irritable, and give a more decided odor of hydride of benzole than the powder itself, also communicate a very distinct sensation of sweetness to the back part of the palate. Heated over the flame, with free access of air, saccharin carbonizes and burns with a dull, yellow smoky flame, leaving a residue amounting to 0.65 per cent. of sodium salts. It does not reduce an alkaline copper solution, but, like glycerine, liberates boracic acid from borax, the latter salt dissolving saccharin readily in aqueous solution, due no doubt to a displacement of the boracic acid.

The strong acids, either hot or cold, show no characteristic color reaction; the compound enters solution at the boiling point of the acid, and in the case of hydrochloric, shows a white granular separation on cooling. Sulphuric acid develops an uncharacteristic light brown color.

The compound, like most of the organic acids, shows a characteristic reaction with ferro and ferrid cyanide of potassium. In the former case no change is perceptible until boiled, when a greenish-white turbidity appears with the liberation of small quantities of hydrocyanic acid. In the latter case also a trace of this acid is set free, with the formation of a very distinct green solution, the latter reaction being very perceptible with a few drops of a 1 in 1,000 solution of saccharin in water. Heated with lime, very distinct odors of benzoic aldehyde are developed.

Saccharin possesses very decided acid properties, and combines readily with alkalies or alkaline carbonates, forming anhydro-ortho-sulphamine-benzoates of the same, in the latter case at the expense of the carbonic anhydride, causing strong effervescence. These combinations are very soluble in water, the alkaline carbonate thus forming a ready medium for the solution of this acid, which alone is so sparingly soluble. Another advantage of some importance is, that while the harshness of flavor perceptible in a simple solution of the acid is destroyed, the great sweetness appears to be distinctly intensified and refined.

The following shows the solubility of the saccharin in the various liquids quoted, all, with the exception of the boiling water, being taken at 60° F.:—

| | | | |
|---|---|---|---|
| Boiling water | 0.60 | parts per 100 | by volume. |
| Cold water | 0.20 | " | " |
| Alcohol .800 | 4.25 | " | " |
| Rectified spirit .838 | 3.20 | " | " |
| Ether .717 | 1.00 | " | " |
| Chloroform 1.49 | 0.20 | " | " |
| Benzine | 0.40 | " | " |

Petroleum ether insoluble.

It is also sparingly soluble in glycerine and fixed oils, and to a greater or less extent in volatile oils. Benzoic aldehyde dissolves saccharin in large quantities.

The quantity of saccharin required to communicate an agreeable degree of sweetness, like sugar, differs with the material to be sweetened, but from half to one-and-a-half grains, according to taste, will be found sufficient for an ordinary breakfast cup full of tea or coffee infusion.

## Difficult Soldering.

A mechanic tells us that if soft solder is to be handled as readily as the ox-hide mixture found in the carpenter's glue pot the mechanic must fit up the surfaces of the joint as nicely as the wood-worker when he is to glue up a frame on the miter. A gluing-up job that must have all the clamps in the shop brought to bear on the joint to squeeze out the glue and crowd the parts together may leave a mitered corner that will pass inspection, but the joiner who can pare down a joint that will fit over the entire surface is going to have a specimen of work that will not as much as show a seam. And so with a job of brazing; two rough surfaces can be brought together without as much as having them cleaned and not only covered over with a layer of borax but heaped up with pieces of glass, and the whole thing bound together with a bale of soft iron wire. A dam is needed for such purpose built up of clay around the seam to hold the liquid brass or "sweating" mixtures, till an affinity is manifested between the surfaces. There are workmen who cannot fill a box with Babbitt metal without first washing the box with alcohol and dusting over the surface with sal-ammoniac wherever a tinned surface is to be formed, and the remaining surface of the box covered with clay wash to protect it against the attack of the fused metal, and if they were to solder a joint that is to be carefully united the surfaces would be nicely fitted with a file and then cleaned thoroughly before bringing the parts together. A piece of tin foil will occupy about as narrow a space as may be asked for and cover the whole surface, and when the work is heated slowly in a fire the parts can be united so nicely that the joint will be almost invisible. This is one of the "kinks" that is brought into use when soldering on a vertical patch, or a patch that must stand in an upright position while it is to be united with a soldering iron. A saddle, which is only a flange coupling for a steam pipe that is to be sweat on to a vertical pipe, brings to mind that solder will not run up hill, and the spacings beneath the saddle must be draining themselves dry as soon as the parts are heated. A fit that almost any one can obtain will bring into play that clinging power that capillary attraction is allied with, and a solid joint is obtained with only the assistance of a Bunsen burner and a solution of hydrochloric acid and zinc. This solution, that the tinman ranks next to that of rosin, readily dissolves the oxide which is continually forming on the surface, and leaves a coating of zinc which the solder has a desire to adhere to. A burner of this kind is used not only for the high heat that it will give but for the convenience of raising temperature without coating the surface with soot, and can be used in almost any place about a building by conducting the gas through several lengths of 1-8 inch pipe. When the copper, known as the soldering iron, is to be made use of on this vertical class of work, or wherever the seam comes on the underside of the joint, the edge of the seam is left as sharp as possible. Beveling the patch on the underside the solder remains without much difficulty. Any one can solder across the upper edge and down each side, but where a workman is cramped for room, he won't get across the under side quite as convenient. By having a thin edge that leaves almost a flat surface to work on instead of a square corner, the solder will have a chance to flow down to the seam and under the joint without the unnatural attempt of running up hill to make the union, or coming the plastic dodge of wiping over the seam with plumber's solder. —*American Artisan.*

### Distillation of Wood.

The *Scientific American* says that the Cadosia Chemical Company, Cadosia, N. Y., has several establishments in that vicinity for the distillation of wood, which has now become an extensive and important industry.

Almost any of the harder varieties of wood will answer, but those chiefly found and used by this Company in the region it now occupies are birch, beech and maple. Pine, hemlock and soft woods will not answer. The general operations and products of the Company are as follows:

Contracts are made with the neighboring farmers for the purchase of standing wood, on which an agreed amount is paid in advance, balance payable as fast as the wood is cut by the Company. The wood is delivered at the works in ordinary four-foot lengths, and is then piled in the distilling retorts, of which there are in the Cadosia still-house 24 pairs. These retorts consist of cast iron, somewhat in the form of a steam boiler, about 10 ft. long and 4½ ft. diameter, having a large manhole at one end, and condensing exit neck at the other end. When a retort is filled with wood the manhole is closed and sealed; a slow fire is then started under the retort. The first products of the distillation, consisting of alcoholic vapors, are passed through a condensing worm, and the liquid thus produced is subsequently redistilled, and this product then sold. Most of it goes to Binghampton, N. Y., where it is refined and put on the market as wood alcohol.

The second products of the distillation, consisting of acetic vapors, are condensed as before described, and the liquid is mixed with lime, thorough mixture being effected by mechanical means, thus producing acetate of lime—used in cloth printing works. The crude acetate is placed above the retorts on racks, where it is dried, and is then ready for market.

The third products of the distillation, consisting of tarry matters and naphthas, are shipped as produced and subsequently refined.

The last products, consisting of heavy tars, are used at the works as fuel. When the distillation is finished, there remains within the retorts a mass of clean and beautiful charcoal ready for market, and all of it is sold to the steel makers. Most of it goes to Troy, N. Y., where it is chiefly used in the production of fine steel.

The principal fuel used in these works is bituminous coal, which, together with the crude lime required, is brought to the works by railway.

We are indebted to a correspondent who resides in the vicinity for these particulars, which are only intended to convey a very general idea of the mode in which some portions of the forests in Delaware County, N. Y., are now being utilized.

The tanning of leather has been and still is a leading industry in this region. This involves the use of large quantities of bark, the trunks of the trees being sawed up and converted into lumber.

Many of the hills in the above vicinity are underlaid with bluestone, and there are several fine quarries of this noble building material.

### Combustion.

The *Mechanical Engineer* explains that the combustion of coal is nothing more nor less than its combination with oxygen gas. When a fuel of any kind combines with oxygen heat is produced. Why fuel should combine with oxygen no one can tell. It is one of nature's secrets. The chemist tells us that the oxygen and the fuel have an "affinity" for each other. But when this statement has been made we are no nearer to understanding why combination takes place than we were before. In text books nothing will be found as to why heat is produced by the combination. On this point an all but universal silence prevails.

We are told, however, by a few writers of the old school, that heat energy was stored up in the coal millions of years ago by the sun, and that this heat energy is liberated when the coal combines with oxygen. This is absurd. It will not be out of place to give here an explanation which is consistent with facts, and therefore appears to be satisfactory.

All bodies, substances, gases and liquids are supposed to be composed of multitudes of particles or molecules of almost inconceivable smallness, and these are supposed to be in motion among themselves. This motion is heat—that is to say, heat is neither more nor less than a kind of motion, and this internal vibration can be transmuted into perceptible mechanical movement; or, on the other hand, mechanical movement can be converted into the invisible motion called heat. How the change takes place no one knows, but the change is none the less a fact. Now, the difference between a solid and a gas is that the motion of the particles or the molecules of the gas is much greater in extent than is the motion of the particles of the solid. Also some gases have a greater range of motion than other gases. If by any means we can take the motion out of gas, say, by compressing it into a vessel the sides and ends of which reduce the range of movement, then, as nothing is lost in nature, the invisible and insensible motion of the gas, which it has lost, reappears as heat in a sensible form, and we find that the sides of the vessel become hot. Now, the oxygen which combines with coal has a very considerable range of internal motion, but when the oxygen has combined with the coal another gas, known as carbonic acid gas, is produced; and the particles of this gas having a much smaller range of motion than the particles of the oxygen have, the difference appears in the form of heat.

It is not unnecessary to tell readers that coal is not always the same. It is composed of various substances and gases. The principal are carbon, hydrogen, oxygen, and certain impurities which make the ash with which we are so familiar. The carbon, hydrogen and oxygen are "elements;" that is to say, they are not composed of separate substances combined together. They cannot be split up into anything else. In 1,000 pounds of anthracite coal there are about 915 pounds of carbon, 35 pounds of hydrogen, and 26 pounds of oxygen. In a good bituminous or North-country coal there will be 800 pounds of carbon, 54 pounds of hydrogen, and 16 pounds of oxygen. The difference between the sum of these quantities and 1,000 pounds is matter entirely non-combustible which appears as ash. Of course, there are an infinite number of variations in the proportions which the constituents of coal bear to each other, but the figures we have given fairly represent good Welsh and good North-country coals respectively.

The air we breathe is composed of two gases—oxygen and nitrogen. The latter appears to have no effect whatever on human life and combustion. It serves to dilute the oxygen. The two gases are mixed; they are not in chemical combination. By weight, approximately, 36 pounds of air contain 28 pounds of nitrogen and 8 pounds of oxygen. In bulk they are mixed in the proportion of, roughly, 4 to 1. Four cubic feet of nitrogen and one of oxygen making five cubic feet of air.

### The Indian Petroleum Fields.

According to those in authority, it is said that Mr. Townsend, the petroleum expert in charge of the Government oil wells at Kattan, in Beluchistan, 50 miles from Sibix, will begin in a few days the deep borings recently decided upon. The commencement of the work has been delayed by the drought, which has prevailed in that part of the country; but the machinery is now in place, and the deep borings will not be much longer delayed.

The indications already obtained by moderate borings show that at a depth of 2,500 feet an annual yield of 50,000 barrels can be obtained when once the live oil has been reached. It will take, it is obvious, some time to do this, and in the mean time the question arises whether the Indian Government is wise in sinking so much money on the relatively insignificant oil fields of Beluchistan while leaving the enormous deposits of Burmah disregarded and untouched. If, from a depth of 200 feet or 300 feet these Burmese oil fields yield more oil than the Beluchistan wells will afford, even when the boring rod has penetrated ten times that distance, the question naturally occurs, why not make a few borings at Yenangyoung to 500 feet or so, instead of driving wells 2,500 feet deep, which, even if successful, will yield only a trifling amount of oil. If the Burmese fields proved as copious as those at Baku—and up to now the surface workings have been sufficiently rich to suggest that they are—then it would be better to work the cheap abundant oil there and send it round to the Indus in tank steamers for use on the Punjaub lines, than to persist in the deep borings in the scanty oil field of Beluchistan. The way that the oil deposits of Burmah are being shelved by the State does not reflect credit on the Indian administration.

It is said that the incandescent electric system hitherto used for the illumination of the Pittsburgh (Pa.) Union Railway Depot is to be changed to that of the Westinghouse alternating type.

The trouble over the site for another gas works for Owensboro', Ky., previously mentioned in these columns, has been dissipated—finally, let us hope—by the purchase of a plot of ground on Third street. The Council has issued the necessary building permit.

The residents of Victoria, Texas, are anxious to have that town lighted by electricity.

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WEDNESDAY, NOVEMBER 16, 1887.

## The Market for Gas Securities.

The city market for gas shares, notably Consolidated, has kept pace with the better tone now prevailing in general speculation. Consolidated, at time of writing (noon, Oct. 14), is bid for at 75, and perhaps the shorts will soon realize a smart shock instead of realizing any profit. They have, however, like the grasshoppers, been dancing all summer, consequently a short period of rest will prepare them all the better for a lengthy lethargic condition. Perhaps the lethargic symptoms may finally culminate in a sleep of the sort that "knows not waking;" for, judging from reliable advices in regard to the business now being done by the Company, and taking into consideration the prospects for the winter, we would not be surprised to see Consolidated stock selling at 85 before the first day of February. Some speculation is being indulged in concerning the declaration of the dividend, the time for which is close at hand. In all probability this will be at the rate of 4 per cent. per annum, although some prognosticators look forward to a half per cent. increase. Equitable keeps steady in the neighborhood of 115, and but little of the stock is offered. Mutual is somewhat stronger, and to us it looks cheap at the figure given. Brooklyn shares are holding their own, notably Williamsburgh. This stock is, beyond doubt, worth more than the quoted prices, and the same remark, perhaps with greater force, applies to Nassau. The St. Louis situation presents no material change, while Chicago matters are more muddled than ever. The Baltimore gas shareholders are about to ratify the terms of the recent agreement, the meetings to be held on the 6th prox. We note that the Chesapeake capital is to be reduced to $2,498,000. Louisville (Ky.) shares are weaker. Some inquiry has recently been made for Washington (D. C.) shares.

## The Crompton Shadowless Arc Light Pole.

In the ordinary mode of suspending an arc lamp intended for the illumination of external areas or spaces the lamp necessarily casts a dense shadow of the supporting pole on one side. To overcome this defect Mr. Crompton has perfected an ingenious artifice which he calls, and with reason, a "shadowless pole," an illustration of his device being herewith given.

The lamp is carried by a steel bracket right above the post, and when the operation of lowering, for the purpose of "trimming," needs to be performed, the lamp is let down at the side of the post by a simple although effective arrangement. By this means the shadow is prevented, and the illumination caused to be symmetrical on the horizontal plane.

A LINE FROM MARLBORO', MASS.—Last February we took occasion to say that Mr. Wm. Anderson had resigned his berth at Chelsea, Mass., in order to assume the Superintendency of the Marlboro' gas plant. His hand apparently has not lost its cunning, because, on Oct. first, the Directors of the Company saw their way clear to make a decided cut in gas rates. Prior to the date mentioned the gross charge was $3 per thousand, whilst the new schedule calls for the payment of $2.50. The wisdom of the concession was proved by an immediate increase in sendout, the returns showing the gain (comparing Oct., '86 with the same month in '87) to have been something over 100,000 cubic feet. Supt. Anderson has just completed the replacing of about 1,000 feet of 3-inch pipe on Main street, having substituted a 6-inch main therefor. We knew the ex-Chelsea member would be heard from soon, and that his voice would have the proper ring.

IS WAS AS IT SHOULD BE.—Some of the Montreal (Can.) gas consumers have been loud in their assertions that the gas supplied them was not up to the standard of illuminating power and purity required by the law; but, as is usual with such complainers, their complaints were not in accordance with the facts. Mr. Aubin, the local Gas Inspector, in answer to the objectors, has furnished averages of his official tests for the months (June 30 to Oct. 31) in which the clamor was loudest, and these show the illuminating power to have been 1.5 candles in excess of the statutory demands. In the item of purity, also, the gas was fully up to standard. The Montreal Company uses iron sponge eked out with lime in its purifiers.

THE Kerr Murray Manufacturing Company is under contract to construct a new 8-inch plant complete to the order of the Charlottesville (Va.) Gas Company. The items include retort house roof, benches, rotary exhauster, annular and multitubular condensers, washer, purifiers, boiler, station meter and street main governor,

## Gas Stocks.

**Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.**

16 WALL ST., NEW YORK CITY.

NOVEMBER 16.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share. ☜

| | Capital. | Par. | Bid | Asked |
|---|---|---|---|---|
| Consolidated | $35,430,000 | 100 | 75 | — |
| Central | 440,000 | 50 | 30 | — |
| " Scrip | 220,000 | — | 47 | 57 |
| Equitable | 2,000,000 | 100 | — | 115 |
| " Bonds | 1,000,000 | — | 113 | 115 |
| Harlem, Bonds | 170,000 | — | — | — |
| Metropolitan, Bonds | 658,000 | — | 110 | 113 |
| Mutual | 3,500,000 | 100 | 91 | 95 |
| " Bonds | 1,500,000 | 1000 | 101 | — |
| Municipal, Bonds | 750,000 | | -- | — |
| Northern | 125,000 | 50 | 30 | — |
| " Scrip | 108,000 | | | |
| Yonkers | | 50 | — | 80 |
| Richmond Co., S. I. | 300,000 | 50 | 50 | — |
| " Bonds | 12,000 | — | — | — |
| Gas Co's of Brooklyn. | | | | |
| Brooklyn | 2,000,000 | 25 | 101 | 103 |
| Citizens | 1,200,000 | 20 | 50 | — |
| " S. F. Bonds | 320,000 | 1000 | — | 103 |
| Fulton Municipal | 3,000,000 | 100 | 128 | 130 |
| " Bonds | 300,000 | | -- | 106 |
| Peoples | 1,000,000 | 10 | 58 | 61 |
| " Bonds (5's) | 368,000 | — | 97 | — |
| " " (6's) | 94,000 | — | 100 | — |
| Metropolitan | 1,000,000 | 100 | 77 | 80 |
| Nassau | 1,000,000 | 25 | 90 | 95 |
| " Ctfs | 700,000 | 1000 | 95 | 100 |
| Williamsburgh | 1,000,000 | 50 | 104 | 108 |
| " Bonds | 1,000,000 | — | 111 | — |
| Out of Town Gas Companies. | | | | |
| Boston (Mass.) Gas Co. | 2,500,000 | 500 | 220 | — |
| Buffalo Mutual, N. Y. | 750,000 | 100 | 90 | 95 |
| " Bonds | 200,000 | 1000 | 95 | 100 |
| Citizens, Newark | 1,000,000 | 50 | 140 | 145 |
| " " Bonds. | 45,000 | — | — | — |
| Chicago Gas Trust | 25,000,000 | 100 | 39 | 40 |
| Cincinnati G. & C. Co. | 6,000,000 | 100 | 182½ | 185 |
| Coasolidated, Balt. | 6,000,000 | 100 | 62½ | — |
| " Bonds | 3,600,000 | | 107 | 107½ |
| Chesapeake, Balt. | 1,000,000 | 100 | 90 | — |
| " | 1,000,000 | | 100 | 102 |
| Consumers Toronto | 1,000,000 | 50 | 192 | — |
| Central, S. F., Cal. | | | — | 84 |
| Capital, Sacramento, Cal. | | | 57½ | 60 |
| Hartford, Conn. | 750,000 | 25 | 140 | 142 |
| Jersey City | 750,000 | 20 | 168 | — |
| Laclede, St. Louis, Mo. | 2,000,000 | 100 | 125 | — |
| Louisville, Ky. | 2,570,000 | 50 | 122 | 127 |
| Little Falls, N. Y. | 50,000 | 100 | 95 | 100 |
| " Bonds | 25,000 | — | 100 | 103 |
| Montreal, Canada | 2,000,000 | 100 | 220 | 221 |